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THE UNIVERSITY OF ALBERTA

QUALITY OF LIFE AFTER CORONARY ARTERY BYPASS GRAFT SURGERY

BY

THERESA MARIE BECKIE ©

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY
EDMONTON, ALBERTA

FALL, 1994

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DEDICATION

To my dear parents, Margaret Ann and Lawrence Beckie, who provide unconditional love, support, and prayers and who by their example instilled the values I am proud to possess.

Quality of Life After Coronary Artery Bypass Graft Surgery

Abstract

This study examines the construct-related validity of perceived quality of life (QOL) of 306 coronary artery bypass graft (CABG) surgical patients. A variety of structural equation models are used to examine the internal consistency of several indicators of QOL and the utility of a variety of theoretical models as predictors of QOL. Biographical and clinical data are also collected and reported.

QOL was measured by five indicators: the Self-Anchoring Striving Scale (Cantril, 1965), the Life Satisfaction item of the Index of Well-Being (Campbell, Converse, & Rodgers, 1976), the Faces Scale (Andrews & Withey, 1976), the Life 3 Scale (Andrews & Withey, 1976) and the Life-as-a-Whole item from the Multiple Discrepancies Theory (MDT) (Michalos, 1991a). The internal consistency of these measures is examined in five LISREL models, all of which fit the data adequately. While QOL can be conceptualized as a global, unidimensional construct, the significant amount of measurement error in all the indicators suggests that they are further away from the concept of QOL than is desirable.

The effects of eight dimensions of perceived health on QOL are found to be diverse. Moreover, two of the QOL indicators behave differentially in relation to the General Health Perceptions dimension of perceived health.

In another model, the effects of the concepts of the Multiple Discrepancies Theory (MDT) are evaluated and are

found to be both theoretically and structurally impressive. The theory is rich and has significant potential for guiding future QOL research. Direct effects from three of the MDT concepts to four of the QOL indicators threaten the validity of these indicators as measures of QOL by breaking down the strict demand for proportionality among all the indicators that is made when QOL is represented as the sole source of these indicators.

A model depicting the effects of satisfaction in four life domains on QOL requires several data-driven modifications in order to conform to the data covariances. A direct effect from one of the satisfaction concepts to a QOL indicator represented yet another threat to the construct validity of the QOL concept. Despite several challenges from the predictor concepts to the proportionality of the QOL indicators, the measurement structure of QOL remained relatively stable.

Finally, the most significant components of the previous models are combined into a single model to examine the best predictors of QOL. The key variable from the MDT (WANTS) and the Satisfaction with Self concept emerge as the most significant predictors of QOL, together accounting for most of the 89.5% explained variance. This model demonstrates that many of the previously significant effects in the prior models predicting QOL were illusory because these are artifacts of the correlation of these concepts with the truly significant predictors, WANTS and Satisfaction with Self.

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TABLE OF CONTENTS

CHAPTER PAGE

I. INTRODUCTION.. 1

Statement of the Problem........................... 1
Statement of the Purpose........................... 3
Research Objectives................................ 4
Conceptual Framework............................... 5
Ethical Considerations............................. 10
Limitations of the Study........................... 11
Significance of the Study.......................... 12

II. LITERATURE REVIEW...................................... 13

Introduction....................................... 13
Historical Explorations of Quality of Life........ 14
The Objective-Subjective Debate.................... 14
Rise of The Social Indicators Movement............ 17
Health Care Quality of Life Research.............. 30
Conceptualizations of Quality of Life............. 36
  Subjective Well-Being............................ 39
  Life Satisfaction................................ 43
  Happiness.. 50
  Health-Related Quality of Life................... 54
Promising Conceptual Efforts....................... 64
Quality of Life of CABG Surgical Patients......... 74
  The Psychiatric Paradigm......................... 75
  The Medical Paradigm............................. 80
  The Well-Being Paradigm.......................... 93
Summary.. 112

III. METHODS AND PROCEDURES............................ 117

Sample... 117
Setting.. 117
Instrumentation.................................... 118
  Global Perceived Quality of Life............. 118
  Index of Well-Being.......................... 119
  Life 3 Scale................................. 121
  Faces Scale.................................. 124
  Self-Anchoring Striving Scale................ 125
  Life-As-A-Whole (MDT1)....................... 128
  Satisfaction With Life Domains............... 129
  The Multiple Discrepancies Theory............ 133
  Perceived Health............................. 138
  SF-36 Health Survey.......................... 138
Data Collection Procedures......................... 149
Hypotheses... 150
Operational Definitions............................ 151
Data Analysis...................................... 154
Summary.. 159

CHAPTER PAGE

IV. THE MEASUREMENT STRUCTURE OF QUALITY OF LIFE....... 161

Introduction.. 161
Characteristics of The Sample......................... 161
  Demographic and Clinical Data....................... 163
    Preoperative Risk Factor Profile.................. 166
    Surgical Data..................................... 171
    Postoperative Complications....................... 175
The Measurement of Quality of Life.................... 178
  Index of Well-Being................................. 179
  Life 3 Scale.. 179
  Faces Scale... 179
  Self-Anchoring Striving Scale....................... 179
  Life-as-a-Whole Item (MDT1)......................... 180
  Descriptive Statistics.............................. 180
  The Internal Consistency of the IWB................. 183
  Correlations Among The Quality Of Life Measures..... 185
Structural Equation Models of Measurement of QOL...... 187
  Measurement of Quality Of Life: Model 1............. 190
    Parameter Specification........................... 190
    Maximum Likelihood Estimates...................... 192
    Evaluation of Overall Model Fit................... 196
    Detailed Assessment of Model Fit.................. 199
  Model 2: The Components of Life 3................... 205
  Model 3: A Model of the Data Collection Process..... 209
  Model 4: The Effect of Life 1 on Life 2............. 213
  Model 5: The Final Model............................ 218
  Attempts To Scale QOL With Different Indicators..... 221
Summary... 223

V. THE RELATIONSHIP BETWEEN HEALTH AND QUALITY OF LIFE.. 225

Descriptive Statistics................................ 226
The Correlations Among The SF-36 Subscales............ 233
Factor Analysis of The SF-36 Subscales................ 235
How Many Factors Underlie The SF-36 Subscales?........ 246
The SF-36 Health Profile of CABG Surgical Patients.... 256
LISREL Models of The Effects of Perceived Health On Quality of Life....................................... 259
Summary... 277

VI. THE EFFECTS OF THE MULTIPLE DISCREPANCIES THEORY ON QUALITY OF LIFE.. 280

Descriptive Statistics................................ 282
Correlations Among The Multiple Discrepancies Theory Items.. 284
LISREL Model Of Effects of The Multiple

Discrepancies Theory On Quality of Life............ 286
Maximum Likelihood Estimates....................... 291
LISREL Model Revisions............................. 297
  Creating A New Concept........................... 297
  Self/Best As An Indicator of QOL................. 297
  Allowing Correlated Measurement Error Variance... 300
  Reduced Measurement Error Variance............... 301
  Additional Beta Coefficients..................... 302
  Additional Lambda Coefficients................... 304
  Scaling The QOL Concept With Life-as-a-Whole..... 315
Summary.. 317

VII. THE EFFECTS OF LIFE DOMAIN SATISFACTIONS ON PERCEIVED QUALITY OF LIFE.......................... 320

Descriptive Statistics............................. 324
Distribution Of life Domain Satisfaction Responses. 326
Correlations Among The Life Domain Satisfaction Variables.. 329
Correlations Among The Life Domain Satisfaction Variables And The Quality of Life Indicators....... 330
LISREL Models Of The Effects Of The Life Domain Satisfactions On Quality of Life.................. 332
  The Effects Of The Life Domain Satisfactions On Quality Of Life: The Satisfaction Scale......... 332
  The Effects Of The Life Domain Satisfactions On Quality Of Life: The Delighted-Terrible Scale... 347
Measurement Error Of The Life Domain Satisfaction Indicators... 351
Summary.. 352

VIII. COMBINING THE BEST COMPONENTS OF THE PRIOR MODELS OF QUALITY OF LIFE............................. 355

Maximum Likelihood Estimates....................... 358
The Standardized Residuals......................... 362
Model Revisions.................................... 366
Summary.. 368

IX. SUMMARY AND CONCLUSIONS........................ 372

Recommendations For Future Study................... 381
Summary.. 383

REFERENCES... 384

CHAPTER PAGE

Appendix A Conceptual Frameworks..................... 409

Appendix B Review of Research on Quality of Life and CABG Surgical Patients Research Designs and Conceptualizations.... 414

Appendix C Review of Research on Quality Of Life and CABG Surgical Patients-Instruments used in Studying QOL in CABG Surgical Patients..... 419

Appendix D Index of Well-Being....................... 428

Appendix E Life 3 Scale.............................. 430

Appendix F Faces Scale............................... 432

Appendix G Self-Anchoring Striving Scale............. 434

Appendix H Satisfaction with Life Domains............ 436

Appendix I Multiple Discrepancies Theory Questionnaire 439

Appendix J The MOS 36-Item Short-Form Health Survey... 443

Appendix K Biographical and Medical Data............. 449

Appendix L LISREL output-Measurement of QOL: Model 1.. 452

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
4.1	Demographic Characteristics of CABG Surgical Patients	164
4.2	Demographic Characteristics of CABG Surgical Patients	165
4.3	Preoperative Clinical Risk Profile of CABG Surgical Patients	169
4.4	Preoperative Clinical Risk Profile of CABG Surgical Patients	170
4.5	Surgical Variables For CABG Surgical Patients	173
4.6	Surgical Variables For CABG Surgical Patients	174
4.7	Postoperative Complications After CABG Surgery	177
4.8	Descriptive Statistics For Quality of Life Instruments	182
4.9	Descriptive Statistics For Quality of Life Instruments	183
4.10	Correlation Matrix Of The Items Of The Index Of Well-Being	184
4.11	Correlation Matrix: Measures of Perceived Quality of Life	186
4.12	Maximum Likelihood Estimates of Model 1 Of Quality of Life	193
4.13	Model 1: The Chi Square And The Measurement Error Of SASS	196
4.14	Maximum Likelihood Estimates For Two Models Of Quality of Life	207
4.15	Maximum Likelihood Estimates Of The Models Of Quality of Life	212
4.16	Maximum Likelihood Estimates Of The Models Of Quality of Life	217
4.17	Maximum Likelihood Estimates Of The Models Of Quality of Life	220
5.1	Descriptive Statistics Of Score Distributions For The SF-36 Health Survey Subscales	227

TABLE **DESCRIPTION** **PAGE**

5.2 Responses To The Health Transition Item Of The SF-36 232

5.3 Correlations Among The SF-36 Health Survey Subscales 234

5.4 The SF-36 Health Survey: Unrotated Principal Component Factors 237

5.5 The SF-36 Health Survey: Varimax Rotated Factors: Principal Components Analysis 239

5.6 The SF-36 Health Survey: Promax Oblique Rotated Factors: Principal Components Analysis 241

5.7 The SF-36 Health Survey: Three Factor Varimax Rotation: Principal Components Analysis 244

5.8 The SF-36 Health Survey: Three Factor Promax Oblique Rotation: Principal Components Analysis 245

5.9 The SF-36 Health Survey: Unrotated Orthogonal Factors: Image Factor Analysis 249

5.10 The SF-36 Health Survey: Varimax Rotated Factors: Image Factor Analysis 250

5.11 The SF-36 Health Survey: Promax Oblique Rotation: Image Factor Analysis 251

5.12 The SF-36 Health Survey: Unrotated Factors: Maximum Likelihood Factor Analysis 252

5.13 The SF-36 Health Survey: Varimax Rotated Factors: Maximum Likelihood Factor Analysis 253

5.14 The SF-36 Health Survey: Oblimin Oblique Rotation: Maximum Likelihood Factor Analysis 255

5.15 Maximum Likelihood Estimates Of The Relationship Between Perceived Health And Quality Of Life 266

5.16 Maximum Likelihood Estimates Of The Relationship Between Perceived Health And Quality Of Life 272

6.1 Descriptive Statistics Of Multiple Discrepancies Theory Items 283

6.2 Descriptive Statistics Of Multiple Discrepancies Theory Items 283

TABLE **DESCRIPTION** **PAGE**

6.3 Descriptive Statistics Of Multiple Discrepancies Theory Items 283

6.4 Correlation Matrix Of Multiple Discrepancies Theory Items 285

6.5 Measurement Error Variance 289

6.6 LISREL Maximum Likelihood Estimates 292

6.7 LISREL Maximum Likelihood Estimates: Final Model 307

6.8 Total Effects Of The MDT Concepts on QOL 309

6.9 Total Effects of The MDT Concepts On QOL Indicators 311

6.10 The Effect Of The MDT Concepts On QOL: Model Revisions 314

7.1 Life Domain Satisfaction Questions: Satisfaction Scale (Campbell, Converse, & Rodgers) 322

7.2 Life Domain Satisfaction Questions: Delighted-Terrible Scale (Andrews & Withey) 323

7.3 Descriptive Statistics For Domain Satisfaction Variables: Satisfaction Scale 325

7.4 Descriptive Statistics For Domain Satisfaction Variables: Delighted-Terrible Scale 326

7.5 Distribution Of Responses To Life Domain Questions 327

7.6 Correlations Among The Life Domain Satisfaction Variables 330

7.7 Correlations Among The Life Domain Satisfaction Variables And The Quality Of Life Indicators 331

7.8 Modeling History 336

7.9 Maximum Likelihood Estimates Of Life Domain Satisfactions On Quality Of Life (Satisfaction Scale) 339

7.10 Maximum Likelihood Estimates Of Life Domain Satisfactions On Quality Of Life (D-T Scale) 349

7.11 Measurement Error Variance of Indicators 352

TABLE	DESCRIPTION	PAGE
8.1	Maximum Likelihood Estimates Of The Combined Model of Quality of Life	359
8.2	Standardized Residuals For The Combined Model Of Quality Of Life	363
8.3	Maximum Likelihood Estimates Of The Combined Model Of Quality Of Life	370

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
3.1	LISREL Model Specification	156
4.1	Sampling Procedure	162
4.2	Model 1: Measurement of Quality of Life: Parameter Specification	188
4.3	Model 1: Measurement of Quality of Life: Maximum Likelihood Estimates	194
4.4	Model 2: Measurement of Quality of Life: Maximum Likelihood Estimates	206
4.5	Model 3: Measurement of Quality of Life: Maximum Likelihood Estimates	210
4.6	Model 4: Measurement of Quality of Life: Maximum Likelihood Estimates	215
4.7	Model 5: Measurement of Quality of Life: Maximum Likelihood Estimates	219
5.1	SF-36 Health Profile Of CABG Surgical Patients Versus U.S. Adults	258
5.2	Perceived Health And Quality Of Life: Hypothesized Relationship Between The Concepts	262
5.3	Perceived Health And Quality Of Life: Maximum Likelihood Estimates	267
5.4	Perceived Health And Quality Of Life: Maximum Likelihood Estimates	271
6.1	The Effects Of The Multiple Discrepancies Theory On Quality Of Life: Parameter Specifications	287
6.2	The Effects Of The Multiple Discrepancies Theory On Quality Of Life: Maximum Likelihood Estimates	293
6.3	The Effects Of The Multiple Discrepancies Theory On Quality Of Life (New Concept): Maximum Likelihood Estimates	298
6.4	The Effects Of The Multiple Discrepancies Theory On Quality Of Life (Self/Best - QOL Indicator): Maximum Likelihood Estimates	299

FIGURE	DESCRIPTION	PAGE
6.5	The Effects Of The Multiple Discrepancies Theory On Quality Of Life: Final Model Maximum Likelihood Estimates	306
6.6	The Effects Of The Multiple Discrepancies Theory on Quality Of Life (MDT1-Scale for QOL) Maximum Likelihood Estimates	316
7.1	The Effects Of The Life Domain Satisfactions On Quality of Life (Satisfaction Scale): Parameter Specifications	333
7.2	The Effects Of The Life Domain Satisfactions On Quality of Life (Satisfaction Scale): Maximum Likelihood Estimates	340
7.3	The Effect Of Satisfaction With Self On Life-as-a-Whole (MDT1)	342
7.4	The Effects Of The Life Domain Satisfactions On Quality Of Life (Delighted-Terrible Scale): Parameter Specifications	348
7.5	The Effects of The Life Domain Satisfactions On Quality of Life (Delighted-Terrible Scale): Maximum Likelihood Estimates	350
8.1	A Combined Model Of Quality Of Life: Parameter Specifications	356
8.2	A Combined Model Of Quality Of Life: Maximum Likelihood Estimates	360
8.3	A Combined Model Of Quality Of Life: Maximum Likelihood Estimates	369

I. INTRODUCTION

Statement of The Problem

Cardiovascular disease continues to be the leading cause of death in Canada (Higginson, Cairns, Keon & Smith, 1992) and in the United States (Prevost & Deshotels, 1993). Coronary artery bypass graft (CABG) surgery is a popular, yet controversial, surgical innovation that has been employed since the mid-1960s as a palliative treatment of coronary artery disease (CAD) (Pollick, 1993). More than 200,000 CABG surgeries are performed annually in the United States (Rosborough, 1993). In the 1988 fiscal year, a total of 16,240 open-heart procedures were performed in Canada, most of which were CABG operations (Higginson et al., 1992). Of the 855 adult open-heart procedures performed in the city of Edmonton, Alberta, Canada in 1993, 595 were CABG procedures.

The expected outcome of CABG surgery is relief of angina, prevention of myocardial infarctions, and improved survival (Allen, 1990; Rosborough, 1993). Prolonged life with CABG surgery has been demonstrated in randomized clinical trials for patients with left main coronary artery disease (Detre, Takaro, Hultgren, & Peduzzi, 1985; European Coronary Artery Surgery Study Group, 1982; Passamani, Davis, Gillespie, & Killip, 1985) and for those who have triple-vessel disease and left ventricular dysfunction (Scott, Luchi, & Deupree, 1988). Yet the enhanced survival for other patient groups remains controversial (Bates, 1990).

Moreover, CABG surgery is expensive, with the need for specialized facilities, trained personnel, and increasingly sophisticated technology (Hemenway et al., 1985; Higginson et al., 1992; Cohen et al., 1993). Necessary reoperations within 15 years substantially adds to the surgery cost (Cameron, Kemp & Green, 1988) and postoperative mortality (Rosengart, 1993; Noppeney, Eberlein, Langhans, & Von der Emde, 1993; Menkis, Carley, & Clough, 1993). Some patients require reoperation for a third time or more (Brenowitz et al., 1988).

Over the last decade, the profile of the patient undergoing CABG surgery has changed quite dramatically (Shinn, 1992; Rosborough, 1993; Disch et al., 1994). Patients scheduled for CABG surgery are older and their medical histories are more complex (Jones, Weintraub, Craver, Guyton, & Cohen, 1991). Compared to younger patients, elderly surgical candidates can expect longer hospital stays and a higher incidence of morbidity (Ytley & Leyland, 1991; Salmon et al., 1991). Advanced age has been shown to increase the risk of operative mortality (Jones et al., 1991; Salmon et al., 1991). Jones and colleagues reported an operative mortality of 6.6% in patients over 70 years compared with 1.8% in patients less than 65 years in CABG patients operated on in 1987. However, Caine, Tait and Wallwork (1993) found that the life expectancy of patients aged 65 years and older who survive cardiac surgery was similar to that of the general population in the same age group. Given that the number of CABG procedures performed annually is increasing, that the cost of these procedures is escalating, that the patient population is older, and that CABG surgery does not prolong the lives of many patients, a strong argument exists for emphasizing quality of life (QOL) as a primary outcome after CABG. Empirical evidence of construct-related validity of measurement scores is lacking for the plethora of measures used to assess QOL primarily because a universally accepted definition does not exist.

Fundamentally, research efforts must focus on the conceptualization and measurement of QOL. More comprehensive research approaches to understanding the predictors of QOL for CABG surgical patients need to be undertaken to facilitate effective decisions for action (Raczynski & Oberman, 1990). There is a significant need for research that contributes to the development of a theoretical framework within which to interpret the experiences of patients undergoing CABG surgery. Without the disciplined guidance of theory, researchers are left with empirical findings that complicate rather than illuminate the nature of the QOL construct.

Statement of The Purpose

The purpose of this study is to gain knowledge and understanding of the concept of QOL through the modeling of a theoretical conception of QOL and to explore how a number of related concepts affect the patient's perceived QOL after CABG surgery.

Research Objectives

The specific research objectives are:

1. To examine the measurement structure of perceived QOL for CABG surgical patients.
2. To evaluate the internal consistency reliability of the multi-item indicators of perceived health and perceived QOL.
3. To determine the magnitude of construct-irrelevant test variance (systematic error) in the measurement of QOL.
4. To determine the appropriateness, meaningfulness, and usefulness of the specific inferences made from the scores of a number of QOL measures.
5. To provide evidence of construct-related validity of the interpretations of the QOL measures for CABG surgical patients.
6. To determine the perceived and objective health status of CABG patients three months after surgery.
7. To determine the effect of perceived health status on perceived QOL of CABG patients.
8. To determine the nomological validity of a conceptual framework (The Multiple Discrepancies Theory) for the interpretation of the QOL of CABG surgical patients.
9. To determine the effect of satisfaction in four life domains on overall perceived QOL.

Conceptual Framework

The conceptual framework which guides this study is that which is outlined by Campbell, Converse, and Rodgers (1976) as well as significant extensions of the framework described by Andrews and Withey (1976) and Michalos (1991a). Campbell et al. define subjective QOL as the satisfaction of needs which is, in turn, determined by the perceived discrepancy between aspirations and achievements. An individual's satisfaction with life is influenced by past experiences and current expectations. Moreover, while overall subjective QOL is thought to be represented by a global, unidimensional, cognitive judgment, personal satisfaction in a number of specific domains of life experience are thought to influence the overall judgment about one's global QOL. Campbell et al. (1976) believe that people evaluate their lives in general terms which may be more than the simple sum of a number of domain satisfactions.

The conceptual model begins with the premise that people live in an objectively defined environment but that they respond to a subjectively perceived environment. Reported satisfaction with a domain of life is thought to depend on an individual's evaluations of various attributes of that domain (see Appendix A). How the attribute is perceived and the standard against which that attribute is judged affects how an individual evaluates a particular domain attribute.

The individual's assessment of an attribute may depend on: one's personal aspirations; one's expectations for the future; equity levels, or the situation that one believes ought to be true in a just society, given how much effort one has invested relative to other people; reference group levels, or what one believes to be true of the current situation of others, such as friends and family in similar situations; personal needs, or the amount of a particular reward required; and personal values, concerning such intangibles as freedom and equity.

In effect, satisfaction is presumed to decline as the gap increases between relevant aspirations and an assessment of one's actual circumstances. Moreover, expressed domain satisfactions are primarily a reflection of the perceived gap between one's perception of the current situation in the domain and one's aspirations concerning the position in that domain. Aspirations are, in turn, shaped by other standards, including the best previous experience one has had in that domain as well as by perceptions of the situation of family members, of the typical citizen, and of friends. Personal characteristics or sociodemographic variables are also thought to have a mild effect on both domain satisfactions and overall perceived QOL.

While the notion of subjective QOL as a function of the discrepancy between aspirations and achievements was a dominant assumption of the framework of Campbell et al. (1976), they did not attempt to measure these discrepancies except for the domains of neighbourhood and housing. They explain that "Our lack of major investment in measurement of aspirations arose less because we were unaware of the conceptual importance of such terms, than because standard ways of arriving at their measurement across a variety of life domains were not at all apparent to us" (p. 172). Campbell and colleagues suggest that the dynamics of aspirations, and the discrepancies between aspirations and achievements ought to receive a high priority in QOL research.

Important developments in testing and extending the gap theory and identifying the sources of individual aspirations is currently being done within the framework of the Multiple Discrepancies Theory (MDT) (Michalos, 1980, 1982, 1983, 1985, 1991a, 1991b). The MDT is an extension of earlier theoretical work (Andrews & Withey, 1976; Campbell et al., 1976), and has been explored by others (Emmons & Diener, 1985; Wright, 1985b; Diener, Sandvik, Seidlitz, & Diener, 1993). Michalos (1991a) outlines how the MDT has been influenced by the basic tenets of aspiration theory, social comparison theory, equity theory, cognitive dissonance theory, and person-environment fit theory. Michalos believes that aspiration and social comparison theories are stronger explanatory predictors than the other theories.

Within the MDT, overall satisfaction and happiness are thought to be causally derived from seven perceived discrepancies. The basic premise of MDT is that a close match between actual life conditions and aspirations will lead to a perceived QOL that is higher than when a large gap between actuality and aspirations exists. Perceived QOL is thought to be determined by an individual cognitively analyzing information about several distinct gaps. These gaps include the gap between what one's perceived achievements and a set of aspirations which are evaluated against (1) what relevant others have, (2) the best one has had in the past, (3) what one expected to have by now, (4) what one expects to have in the future, (5) what one deserves, and (6) what one believes one needs (Michalos, 1991a). Moreover, there is an indirect effect, mediated through the discrepancy between what one has and what one wants, from all the other discrepancies on overall life satisfaction (see Appendix A). In support of the premises of the MDT, Staats & Partlo (1993) suggest that when individuals are presented with a single, global item, they engage in some sort of averaging of multiple discrepancies in order to arrive at a global assessment of well-being.

The strengths of MDT include the provision of parsimony, clarity, and simplicity as well as a significant potential to contribute to the understanding of how perceived QOL is formulated. MDT has successfully predicted perceived QOL or global satisfaction as well as satisfaction in 15 life domains. Therefore, it is conceivable that the MDT could become a general theory of QOL which is applicable to a wide variety of populations.

In general, subjective and objective measures of well-being or QOL are not highly correlated. For example, people who appear objectively well off often report below average levels of subjective well-being (SWB) (Rodgers, 1977). Similarly, Campbell and colleagues (1976) found that black males living in poverty reported a level of satisfaction with their housing which was similar to the responses of affluent Americans. The MDT offers theoretical explanations of these aberrant findings; the black males likely have low aspirations and the affluent Americans likely have high aspirations. The higher aspirations of affluent Americans can be expected to produce a large discrepancy compared to achievements, leading to a low SWB. Another strength of the MDT is that it appears to provide an accurate representation of the real world. An empirical exploration of the fit of this theory to the real world of CABG surgical patients has potential for clinical significance for health care professionals caring for these patients.

In order to develop a better understanding of QOL, more theoretical and methodological work is required. Michalos (1991a) maintains that a well developed theory of SWB would provide explanations and predictions of how individuals' formulate reported satisfactions. He goes on to say that:

> It would be applicable to satisfaction or happiness with life as a whole (i.e. global satisfaction or happiness) as well as to satisfaction or happiness with specific domains of life (domain satisfaction) such as marital satisfaction and job satisfaction. The theory would be able to explain why people are happy or satisfied with their whole lives as well as with their jobs, living partners, finances, health and so on. The theory...which I call Multiple Discrepancies Theory, or MDT for short is just such a theory (p. 4).

Ethical Considerations

The University of Alberta policy related to ethics in human research as well as the guidelines on research involving human subjects outlined by the Medical Research Council of Canada (1987) were followed throughout this study. Ethical clearance was granted by the University of Alberta Hospitals Special Services and Research Committee. Moreover, approval to conduct the study was obtained from the Division of Cardiothoracic Surgery and the Medical Ethics Committee of the Faculty of Medicine, University of Alberta.

The investigator approached all patients considered eligible as study participants just prior to their first follow-up visit with their cardiothoracic surgeon to determine their interest in participating in the study. All patients expressing an interest in the study received a copy of the consent form and questions regarding the study were answered. Participants signed the consent form after voluntarily agreeing to participate in the study and after verbalizing an understanding of the objectives of the research.

Patients were informed of the opportunity to withdraw from the study at any time without jeopardizing their present or future health. Confidentiality of information, the right to refuse participation, and anonymity in reporting of findings was explained and recorded on the consent form.

Limitations of the Study

Acknowledged limitations of this study will facilitate the interpretation of the study results and serve to delineate the direction of future research. The first limitation of this study is that the CABG surgical patients were not selected on the basis of probability sampling procedures. Thus, it is inappropriate to infer that the results of the study will apply to CABG surgical patients from any medical centre outside of Edmonton, Alberta, Canada. However, it was not an objective of this study to make comparisons with other centres.

The second limitation stems from the fact that the study was cross-sectional rather than longitudinal. Therefore, changes in QOL were not ascertained. Moreover, a pre-experimental survey design does not permit determination of the temporal relationship between related variables. The direction of causality is, therefore, guided primarily by theoretical rather than empirical considerations.

A third limitation of this study is the fact that a limited number of latent and manifest variables are included in the QOL models tested in this study. The consequence of this limitation is that it is impossible to isolate unknown and unmeasured influences of omitted variables on the variables which are included in the study models. That is, the determination of causality is threatened by these omitted influences. Replication of the findings of this study with another sample of individuals will be a necessary validity check particularly if the models require revisions. If many revisions are necessary, the potential for capitalizing on chance significance with one study sample increases.

Significance of The Study

Despite the popularity of CABG surgery, little is known about the QOL of these patients from their perspective. This study addresses this gap in knowledge by examining the structure of the concept of QOL as well as the relationship between a number of variables and the QOL concept. The study is directed at a primary goal of providing construct-related evidence of the validity of the interpretation of a variety of measures of the QOL construct as well as the relationship of related constructs and the QOL construct. No systematic study has been made of the nomological network of QOL and related constructs in relation to CABG surgery. In particular, the study adds clarity to the nature of the relationship between the construct of QOL and the construct of perceived health.

II. LITERATURE REVIEW

Introduction

Quality of life (QOL) has been the subject of study for over 50 years. Researchers of the Social Indicators Movement (SIM) have contributed significantly to the determination of both the relevant indicators and the most powerful predictors of QOL (Andrews, 1991). The development of modern medical technology over the past 50 years has produced life saving techniques that medical scientists of past generations might not have imagined (Jenkins, Jona, Stanton, & Stroup-Benham, 1990). As patients are increasingly surviving both acute and chronic illnesses, survival statistics become less discriminatory and evaluation of medical interventions must increasingly be focused upon measurements of the broader concept of QOL. Schipper (1992) argues that QOL could become the dominant criterion upon which decisions are made.

QOL is a complex phrase that has generated an enormous literature and has become the object of a great deal of research, controversy, and academic attention (Edlund & Tancredi, 1985). As a concept, QOL is open to a myriad of ideological uses, as well as potential abuses. The purpose of this section is to provide a historical review of the literature involving the conceptualizations and theoretical developments of QOL. This is followed by a review of the QOL research in relation to CABG surgery.

Historical Explorations of Quality of Life

Quality of life is a concept that has various levels of conceptualization and definition although a universally accepted definition has evaded researchers (Levine & Croog, 1985; Headey, Holmstrom, & Wearing, 1985; Wright, 1985a). Although the term QOL has been widely used coloquially for some time, its use as a scientific construct is relatively recent. Hence the phrase is conceptualized and measured differently by sociologists, health care professionals, and social psychologists (Gehrmann, 1978; Bryant & Veroff, 1986; Fletcher & Bulpitt, 1988; Guyatt, Van Zanten, Feeny, & Patrick, 1989; Horowitz, 1979; Berg, Hallauer & Berk, 1976).

Because QOL is often conceptualized and measured differently, meta-analyses of the QOL research both between and within disciplines are nearly impossible; this hinders the consolidation of new knowledge and theory building. Optimistically, though, the ambiguity in the conceptualization of QOL provides opportunities for researchers to generate and test new theories.

The Objective-Subjective Debate

There has been, historically, two basic conceptualizations of QOL - conditions of life and experience of life (Andrews, 1981). Conditions of life are objectively measured factors without regard to people's perception of these conditions whereas experiences of life are measured by subjective perceptions of life under given circumstances.

Shye (1989) argues that the terms "QOL" and "quality of the environment" are often confused in the literature. Quality of the environment is the extent to which the physical environment promotes the QOL of affected individuals. Thus, quality of the environment is not only a distinct notion from that of QOL, but also, requires different assessment procedures. Hence, while QOL data are directly obtained from the individuals concerned, quality of the environment data is derived from a variety of sources in the attempt to gather evidence concerning possible causal relationships.

The debate continues about which measures of QOL are more valid: those that are objective or those that are subjective (Najman & Levine, 1981; Wish, 1986; McCullough, 1984; Davis & Fine-Davis, 1991). Campbell (1976) has argued that subjective indicators assess the experience directly, whereas objective indicators merely measure factors that influence the experience. Objective environmental and social indicators must be properly regarded as but indicators of the physical or social conditions prevailing in an individual's life (Shye, 1989). As such, they do not constitute part of the QOL definition.

QOL is a vague and ethereal concept, which, like beauty, is best described from the point of view of the beholder; its true meaning must come from the individual concerned. QOL is very much a personal experience and attribute (Olweny, 1992). Campbell (1976) argues that society has a responsibility to assess and monitor the SWB of its members and that measures of SWB should be included in social indicator systems. By monitoring such measures over time, societal decision-makers can assess the need to improve SWB and evaluate the effectiveness of policies and programs designed to produce such improvements (Yardley & Rice, 1991). Supporting this position, demographic variables have consistently shown only modest relationships, if any, to most self-assessments of life quality (Campbell et al., 1976; Andrews & Withey, 1976; Abbey & Andrews, 1986; Johnston, 1988; Mastekaasa & Kaasa, 1989).

The omission of attitudinal data is a serious defect in any QOL assessment because it is not the objective situation itself, but rather how that situation is perceived, that governs human behavior (Campbell et al., 1976). Davis & Fine-Davis (1991) suggest that subjective indicators can also provide clues as to which objective indicators are more worthy of attention since a very large array of objective conditions may be examined in relation to an individual's sense of well-being. Most QOL assessments appear to be dictated by data that are easy to count and measures that are readily available, by the ideas and values of the researcher, and by the predominant paradigm of the researcher's profession rather than by the demands of a prior theory which is solidly grounded in rich and relevant data.

Rise of The Social Indicators Movement

The earliest attempts to study QOL began 50 years ago as a component of cross-sectional population surveys. The goal of these early studies was to determine the affect of demographic variables and environmental living conditions of various populations on the perceived satisfaction with these living conditions. These studies generally addressed questions of policy making, program planning, and national priorities such as the space program. Many of these studies focused on the objective aspects of specific life concerns such as housing, income, employment, and local government.

Social indicators and measures of QOL have been a part of American social science since the early 1930s when President Hoover requested a broad description of trends in American life from a group of leading social scientists. Generally credited as the first major attempt to actually measure the quality of American life and to construct a set of social indicators, the authors of the Report of the President's Research Committee on Social Trends (1933) acknowledged that "there are important elements in human life not easily stated in terms of efficiency, mechanization, institutions, or rates of change" (p. IXXV). The recognized deficiencies in economic indicators for social monitoring and evaluation were a significant factor in the growth of the SIM. Despite a commendable start, social indicators research received little attention until the 1960s (Bauer, 1966). The volume edited by Bauer (1966) was motivated by a concern for public policy decisions. The authors saw social indicators as useful in evaluating social programs and in providing a key to social policy development.

In the absence of any direct means of assessing subjective QOL, economic indicators were used to gauge progress toward social goals, on the assumption that economic well-being was a major determinant of SWB. The gross national product has been employed as an economic yardstick in Presidential budget messages since 1944, and it has been a useful concept for the purposes of economic accounting and monitoring. However, it became evident that cost-benefit analyses, the availability of goods and services, and other easily quantifiable statistics were inadequate data by which to judge issues of social justice, health and illness, or SWB.

That economic yardsticks were inadequate measures of various aspects of well-being was very evident by the early 1970s. Economic welfare was perceived as a necessary but insufficient condition for SWB. Consumption of goods and services are deemed meaningless measures of QOL unless placed in the context of life aspirations and goals embraced by individuals in which the use of these goods and services plays a role in fulfilling. Dissatisfaction with economic indicators has led to various attempts to develop an alternative set of social indicators to more accurately reflect SWB.

The 1970s was a period of rapid growth of the SIM; a movement whose impact is felt today in much QOL research. The greatest single achievement of the SIM was the search for and development of relevant and representative measures of subjective indicators of societal well-being. These pioneering attempts to develop measures of SWB also made a significant contribution to theoretical accounts of the dynamics of SWB.

Much of the empirical work on life quality in the 1960s and early 1970s focused on finding effective ways to measure well-being and applying these measures to broad general populations. The measures of QOL ranged from purely objective indices of economic and social conditions to the more subjective and psychological measures of happiness or SWB of the population. Despite the huge gains in social science methodology since the 1930s and the Hoover Commission, there is still no consensus as to what composes the valid QOL concept or how to measure it (Williams, 1991).

One of the first major population surveys of SWB was conducted during the late 1950s in the United States (Gurin, Veroff & Feld, 1960). The researchers investigated the level of psychological and emotional stress in the communities. Although the focus of the study was mental health rather than the QOL or SWB studies of the 1970s and the 1980s, the study successfully demonstrated the utility of survey techniques for studying subjective aspects of life. The survey questionnaire included items about worries, fears of a nervous breakdown, satisfaction with life, happiness, and optimism for future happiness. These measures comprised items of a more affective as opposed to a cognitive nature. This study was replicated on another sample of American adults nearly 20 years later (Veroff, Douvan & Kulka, 1981).

Taking a slightly different approach to the study of well-being of 5 samples of American people, Bradburn and Caplovitz (1965) chose to explore further the affective aspects of life experience, that is, avowed happiness. These non-random samples provided data from a wide range of heterogeneous American respondents; data which has since been replicated in part by Andrews and Withey (1976). Bradburn (1969) was interested in the subjective feelings experienced by individuals in daily life. After determining both the positive and the negative experiences of his respondents' recent past, Bradburn identified two measures of affect, positive and negative, which were thought to be unrelated to each other. The Positive Affect, the Negative Affect, and the Affect Balance scale (Bradburn, 1969) emerged from this work and have been widely used, though not always uncritically, since.

In constructing the Affective Balance Scale, Bradburn and Caplovitz (1965) rejected the health-illness framework and the presuppositions of the medical model in re-defining the focus of research as psychological well-being. According to Bradburn's model, well-being is a quality of experience that arises from the relative prevalence of positive or negative affect. The debatable part of Bradburn's model is the claim of independence between the levels of positive and negative affect.

While Bradburn (1969) was conducting his study of Americans in the early 1960s, Cantril (1965) was embarking on a large multinational study of SWB. QOL, according to Cantril (1965), is a function of individual assumptions, perceptions, aspirations, and values. That is, QOL is conceptualized as a cognitive experience whereby subjective perceptions of one's current life situation are compared to situations aspired to, expected, or felt deserved. The discrepancy between one's perceived life and the life aspired to is seen as an expression of satisfaction or dissatisfaction with greater satisfaction being indicative of a higher SWB.

Cantril (1965) developed the Self-Anchoring Striving Scale (SASS) to assess the SWB of people in 13 countries. The scale consists of a runged ladder which depicts the best to worst possible life. By identifying a position on the ladder the individual is indirectly reflecting a level of life satisfaction. People were asked to indicate the level of their SWB 5 years prior to the study, at the time of the study, and their expected level 5 years after the study.

The scale was administered repeatedly to Americans between 1959 and 1974. Across the years, no changes in the subjects' ratings of their life satisfaction were observed. Although one might expect increased satisfaction with increased standard of living, Campbell et al. (1976) hypothesized, that Cantril's inability to detect change in life satisfaction indicated that individuals adjust their expectations in response to changes in their life situations. Their changed expectations are then reflected in their ratings of satisfaction with their lives.

Canadian researchers have found quite different results (Horley & Lavery, 1991). Over a 7 year period, during an investigation of the stability and sensitivity of several SWB measures, Horley and Lavery found that the SASS was the most sensitive measure of change among a number of SWB scales. They attributed this sensitivity to the cognitive nature and ipsative phrasing of the tool. That is, the subject defines the range of satisfaction. Since the extremes are entirely personal, the meaning of the endpoints is relatively constant for an individual over time.

The Research Group for Comparative Sociology, at the University of Helsinki, conducted the Scandinavian Welfare Study in 1972. Nationally representative samples from Denmark, Finland, Norway, and Sweden were surveyed. The study covered a broad range of topics, including global happiness and satisfaction with income and status (Allart &

Uusitalo, 1977).

Another series of surveys on SWB were carried out in the mid-1970s on samples in 60 countries said to represent two-thirds of the world's population by the Gallup International Research Institutes (Gallup, 1976). The surveys explored issues of personal happiness and satisfaction with a variety of life domains. These life domains included job, leisure and recreation, education, health, family life, standard of living, and personal safety.

Subjective QOL and happiness has also been assessed through the Eurobarometer surveys conducted annually beginning in 1973 in most of the countries of the European Economic Community. Andrews and Inglehart (1979) found substantial similarities in perceptions of SWB between European countries. Inglehart and Rabier (1986) provided a detailed discussion of the variations in SWB and happiness between nations and over time. They found significant empirical support for the aspiration-achievement model first discussed by Cantril (1965). SWB showed little variation between social groups but a large variation between societies. Moreover, a cultural component to a nation's reported SWB was found. Overall, cross-national expressions of SWB between 1973 and 1983 were remarkably stable.

In the late 1970s a research team, at York University in Toronto, investigated the subjective QOL of Canadians. Nationally representative samples of Canadian adults were surveyed in 1977, 1979, and 1981; representative samples from Toronto and Montreal were also participants in a three-wave panel study of QOL (Atkinson, 1981; Blishen & Atkinson, 1980). One of their particular interests was to examine the relationships between objective and subjective indicators. This study was implemented to coincide with other Canadian national surveys.

Three nationally representative welfare surveys were conducted between 1978 and 1984 to assess the QOL in West Germany. These large national studies involved measuring both objective and subjective dimensions in a selected number of life domains (Zapf & Glatzer, 1987). German official statistics are traditionally restricted to objective data; they do not investigate, in principle and by law, opinions, evaluations, and values of the public. The social scientists who bridged the gap between the objective and subjective indicators are members of the Sonderforschungsbereich 3 Frankfurt/Mannheim. This is a research unit funded by the German Science Foundation and is the most important type of public funding outside directly sponsored government research and development.

The overall picture of the German Federal Republic was that of an affluent society with high objective and subjective welfare levels. In general, the German population was characterized as satisfied and happy with their lives. However, there was a remarkable increase in the proportion of pessimistic respondents who expected lower life satisfaction in the future (12% in 1978 to 25% in 1984). The authors suggest that a positive development in "this environment ill-suited for social research" (p.11) is a new awareness on the part of the official statistical agencies that they should collaborate with social scientists in order to secure their own programs and in order to insure progress in social information.

A large study in Australia has made important contributions to current knowledge about the causal direction in SWB research (Headey, 1981; Headey, Glowacki, Holmstrom & Wearing, 1985; Headey, Holmstrom & Wearing, 1985; Headey & Wearing, 1990; Headey, Veenhoven, & Wearing, 1991; Headey, Kelley, & Wearing, 1993). The data from four waves of the Australian Quality of Life Panel Study obtained in 1981, 1983, 1985, and 1987 were used to assess the causal direction between six domain satisfactions and SWB. A strong relationship between events occurring in specific domains of life and changes in domain satisfactions was found. Moreover, some life domains were characterized by two-way causation while other domains of life were spuriously related to SWB. More recently, life satisfaction and depression have been found to be negatively correlated (Headey, Kelley, & Wearing, 1993).

One of the largest ongoing studies of SWB is the General Social Survey (GSS) conducted biannually since 1980 in the

United States. The annual GSS conducted by the National Opinion Research Center (NORC) between 1972 and 1978, mainly concerned with social-psychological and socio-political attitudes of the American population, have provided survey data of different samples from the same population for over 15 years (Davis, 1988). The GSS has included questions assessing global happiness and satisfaction with certain specific life concerns. In 1984 the primary concerns included geographic location, non-working activities, family life, friendships, and health. Davis (1984) presented a useful summary, noting that marital status and recent financial changes are among the best predictors of happiness. The GSS has been the major source of data on SWB in the United States during the 1980s.

Of all the investigators exploring subjective QOL, two groups of researchers have unquestionably left the strongest influence on how subjective QOL is conceptualized and studied today. These QOL researchers from the Michigan Institute for Social Research (Campbell et al., 1976; Andrews & Withey, 1974, 1976) conducted what now is considered a classic series of studies in the United States to determine the individuals' perceptions of SWB. These investigators, particularly Andrews and Withey (1976), gave considerable attention to global measures of SWB and perceived QOL. They also included measures of satisfaction with respect to life domains or specific life concerns. Consistently, they found that most life satisfaction was derived from life domains which were personal, broad in scope, and central to the individual.

Andrews and Withey presented data on almost 200 different measures of life quality (68 measures of global SWB and 123 measures of specific life concerns) that were assessed on nationally representative samples (N=5,422) between the spring of 1972 and the fall of 1973. Their model comprised two dimensions of subjective QOL: domains of life such as job, health, and family life, and concerns (values or criteria) such as achieving success, amount of challenge, and independence and freedom, by which one judges or evaluates perceptions of the various domains of life. Andrews and Withey (1976) produced 800 possible QOL factors through an extensive literature review. After discarding overlapping items the list was reduced to 100. With the use of small space analyses and factor analysis, a final list of 36 life domains were considered important. The sum of all possible interactions between criteria and domains is the individual's subjective QOL.

Campbell et al. (1976), believing that satisfaction was the appropriate subject underlying SWB, asked respondents to describe and evaluate their experiences in 15 separate domains of life and to respond to more general measures regarding their lives as a whole. Satisfaction was chosen to define the SWB construct because it suggested a cognitive, judgmental experience which was conceptually consistent with the notion that QOL is determined by judgment and evaluation of life concerns. Satisfaction also suggests a more permanent subjective state than does happiness. Campbell et al. (1976) found that individuals think in terms of life satisfaction when conceptualizing QOL; Andrews and Withey (1976) provided evidence to support this conceptualization.

Campbell et al. completed a national survey in 1971 and then replicated it in 1978. Their 1978 survey included a panel component in which many of the respondents interviewed in 1971 were re-interviewed 7 years later. Angus Campbell (1976), an eminent social psychologist, was primarily concerned with finding ways to conceptualize and measure the psychological quality of American life. Since his death in 1980, few researchers have contributed as significantly to the current understanding of the concept of QOL.

An unexpected yet consistent finding to emerge from early research on SWB is that demographic variables such as age, sex, race, education, and income show little relationships to most self-assessments of life quality (Michalos, 1985; Abbey & Andrews, 1986). It is generally the case that when such factors are analyzed by multivariate analyses they explain less than 15% of the variation in assessments of QOL as a whole, and rarely much more than that in assessments of specific life domains. The relationships that do appear are in the expected directions but demographic factors do not show strong potential for explaining much variation in SWB.

Davis (1984) found higher SWB among people who experienced increases in income, who were married, who were well educated, and who had social support--results that are replicated in many other studies. Little or no gender differences have been found in the various SWB indices (Shmotkin, 1990; Andrews, 1991). There is little difference between age groups, depending more on the particular measure used to assess SWB. Religious satisfaction is considered to be important for general life satisfaction and existential well-being (Poloma & Pendleton, 1990; Meadow, Mentzer, Rahtz & Sirgy, 1992).

Substantial progress has been made by social scientists in searching for effective means of measuring SWB, in determining the relationships between various aspects of life, and in reporting how various national and demographic groups view their global subjective QOL as well as life in specific life domains. A significant amount of work is required to thoroughly evaluate and improve the psychometric properties of SWB measures, as well as to determine the significant variables that are important predictors of how one's subjective QOL is evaluated. The answer to this question must be resolved before decisions are made based on an individual's subjective QOL.

Researchers of subjective QOL have also explored the relationship between SWB and various personality and psychological variables such as self-esteem, neuroticism, optimism, and type A behavior. This has lead to a new interest in the medical community for studying QOL. Unfortunately, the knowledge that social psychologists have gained about subjective QOL over the years have not readily been utilized by the medical community. Instead, health care professionals have tended to conceptualize QOL as health status and physical functioning. This has lead to conceptual confusion and an array of definitions of QOL.

Health Care Quality of Life Research

Improving QOL is increasingly the major goal in the provision of cost-effective health care. During the last decade, the elusive concept of QOL has dominated the focus of research, controversy, and debate in the field of health care. QOL is often discussed in the context of treatment selection, evaluation of therapeutic interventions, and health care budget constraints (Teeling Smith, 1988). The rationale for measuring QOL include justification for different forms of medical treatment and identification of the sequelae of disease which may be resolved by particular therapeutic interventions (Goodinson & Singleton, 1989).

Clinical researchers are beginning to recognize the inadequacies of evaluating the delivery of health care solely in terms of outcome measures such as mortality, recurrence of symptoms, or purely physiological measures of disease. There is an increasing awareness of the importance of determining the impact of a treatment on the patients' subjective QOL. However, many randomized clinical trials focus exclusively on more objective measures of patient progress so that how the patient actually feels and functions in daily life does not directly enter into the comparison of treatments (Pocock, 1991). Cardinal clinical end points are important health outcomes independent of QOL and it is bewildering why they are perceived as a dimension of QOL (Williams, 1991).

The demand for QOL assessments as an endpoint for medical intervention or clinical research has become increasingly popular within the medical community (Schumacher, Olschewski & Schulgen, 1991; Cleary et al., 1993; O'Brien, Buxton, & Patterson, 1993). Although improved QOL is often cited as an outcome measure of medical interventions, how to measure "quality" remains open for debate. Of the major reviews of QOL studies subsequent to medical therapy, the consistently drawn conclusion is that most studies are hampered by poor design and inadequate assessment methods (Bowling, 1991; Veldhuyzen Van Zanten, 1991). In a review of more than 250 references mentioning QOL in the title, Calman (1987) found that few authors defined what was meant by the phrase. The lack of consensus on a definition of QOL has complicated the measurement of QOL. Reviews of clinical trials of treatment also reveal that the words QOL were mentioned in between 3-50 percent of studies but actually measured in fewer than 2-7 percent (Bardelli &

Saracci, 1978; O'Young & McPeek, 1987).

Although health professionals have general impressions of the QOL concept, most are unsure of the specific components requiring evaluation and how to validly measure them. They tend to focus on objective measures of QOL, rarely considering subjective measures. Generally, the objective approach assumes that health, physical functioning, and other quantifiable indicators are valid measures of QOL, and that there are absolute standards for assessing these variables. Measuring objective physical functioning fails to capture QOL because of the neglect of underlying cognitive processes that mediate patient perceptions of QOL (Cella, 1992). Less frequently utilized, subjective approaches attempt to assess qualitative perceptions of illness. Such approaches consider more idiosyncratic evaluations by individuals and do not link QOL to absolute or standard variables.

Antonovsky (1982) believes that the paucity of subjective data about QOL of ill individuals results from studies which present with a pathogenic orientation; an approach which pressures one to focus on the illness, blinding one to the subjective interpretation of the person who is ill. The differences between the subjective and objective dimensions of QOL are substantial, and choosing one over the other has important implications for how the measures are interpreted. A move is underway to correct the neglect of subjective perceptions of QOL. Schipper (1992) argues that QOL can be viewed as a final common pathway measure representing the net effect of disease and all medical and psychosocial therapies implemented from the perspective of the patient.

Gill (1984b) states that "The real world of an individual is what that individual perceives it to be: no more and no less" (p.684). Thus, for example, if health is to be considered an predictor of QOL, then it is the health of individuals as they perceive it that will provide the most valid interpretation. Presant (1984) argued that physicians were relatively incapable of adequately describing patients' QOL after he found low correlations between patients' and physicians' assessment of QOL. Pearlman and Jonsen (1985) found that physicians' assessment of the QOL of patients "demonstrated marked variability", and they recommended deferring judgments to patients whenever possible.

More recently, Molzahn (1989) conducted an extensive study of the perceptions of 215 end-stage renal disease (ESRD) patients and their physicians and nurses regarding the patients' QOL. Conceptualizing QOL as a unidimensional, global construct, three instruments were used to measure QOL: Cantril's (1965) SASS, the Index of Well-Being (Campbell et al., 1976), and a health state utility score (Torrance, 1986). Molzahn found a statistically significant difference between both nurses and physicians, and the patients' perceived QOL. Patients' ratings on the SASS were significantly lower than the physicians ratings. The correlations between physicians' ratings and patients' ratings over all the QOL measures ranged from 0.26 to 0.45. Interestingly, Molzahn discovered that the physicians' understanding of the patients' QOL were closer to the patients' perceptions than were the nurses' perceptions.

Health has repeatedly been shown to be one of the most important of the domain variables that affect QOL (McNeil, Stones & Kozma, 1986; Michalos, 1986b). However, health is not a fundamental component of the definition of QOL. It is a determinant of QOL and it should be treated as such. If health is an important outcome variable then it should be studied accordingly but it should not be thought of as an inherent part of QOL. Since QOL involves value judgments that are highly subjective, it reasonably follows that the scores from direct measures of SWB possess more construct-related evidence of validity than measures of health status (Dubos, 1976; Benner, 1985; Larsen, Diener, & Emmons, 1985; Najman & Levine, 1981).

Because the focus of QOL has been largely on objective indicators of disease, physical health, and work status, health care providers have often been considered the most appropriate for developing QOL measures (Burckhardt, Woods, Schultz & Ziebarth, 1989). However, few researchers have asked chronically ill or disabled individuals to define the important domains that constitute QOL. Those who have done so found no evidence that the chronically ill focus on their disability or respond in any substantively different manner from non-disabled persons (Chwalisz, Diener & Gallagher, 1988).

There is considerable evidence to support the premise that physical illness contributes very little to general perceived well-being (Wheeler, 1991). This research also supports the distinction between well-being and ill-being which have separate correlates and causes (Headey, Holmstrom & Wearing, 1985). Even though well-being and ill-being are independent, Headey and colleagues demonstrated that a combined measure provided greater explanation of variance than separate measures. Angel and Thoits (1987) report several studies showing that "there is only an imperfect correspondence between the clinical fact of disease and the subjective experience of illness" (p. 466), and even the most devastating circumstances can have a relatively small impact on subjective QOL.

It is clear that efforts to conceptualize QOL as a construct have been complicated by the use of other constructs presumed to be analogous. Concepts such as SWB, satisfaction with life, happiness, morale, health status, and role functioning have been used as indicators of QOL (Diener, 1984). Studies of self-assessed happiness, satisfaction with life, ability to function personally and in society, and general health status are sometimes redefined as constituting research on QOL. However, the relationship of these constructs to the QOL construct has still to be properly assessed and integrated (Bunge, 1975). Providing evidence for the nomological validity of the QOL construct is a process in need of serious research attention. Campbell and Fiske (1959) maintain that for the validation of test interpretation, and for the establishment of construct validity, discriminant validation as well as convergence validation is required. A discussion of the conceptualizations of QOL from the perspective of the SIM and the health care field follows.

Conceptualizations of Quality of Life

Confusion remains over both the definition and measurement of QOL (Molzahn, 1990). Quality can be defined as a grade of "goodness" (Bowling, 1991). Schuessler and Fisher (1985) state that quality implies a range from high to low or from better to worse. However, they suggested that because life has numerous dimensions, it is more difficult to define. Andrews and Withey (1976) also recognized the complexity of the QOL concept when they initially identified 800 possible life factors thought important for its assessment.

Questions concerning which features of life or universal goods are of intrinsic value and which may contribute to QOL have been debated for centuries. Olsen and Merwin (1977) have observed that "whatever contributes to the QOL of a population is ultimately determined by them, not by elites of any kind, and people's notion of life quality is thoroughly infused with normative values concerning what is good and right in life" (p.46). It follows that every QOL study must assess the individual's conception of QOL.

Young and Longman (1983) define QOL as the degree of satisfaction with present life circumstances as perceived by the individual. Carter (1989) views QOL as a subjective interpretation made individually and grounded in uniqueness and situation. Coyle (1992) takes this a step further by suggesting that QOL is an overall gestalt that relates to the positive experience of life satisfaction, personal integrity, autonomy, and personal worth. Thus, QOL is difficult to define because it relies on individual interpretation.

Despite this lack of consensus on a definition of QOL, there appears be a general agreement in the literature that QOL is a multidimensional construct (Shye, 1989; Palys & Little, 1980; Gillingham, 1982; Roy, 1992; Lim et al., 1993). However, Molzahn (1989) believes that subjective QOL is a global, unidimensional construct. She suggests that researchers espousing the multidimensional nature of QOL mistakenly attempt to aggregate scores on a number of variables representing these various dimensions. She quite correctly points out that if QOL is multidimensional, then one cannot meaningfully sum the scores across these dimensions. However, even separate scores on all these different variables are not likely tapping the same domain as the global QOL construct. Rather, as Molzahn suggests, these variables are predictor or determinants of QOL; related constructs but of a different content universe.

There is now a degree of consensus among researchers in the social psychological disciplines that three aspects of SWB can be distinguished (Andrews & Withey, 1976; Headey & Wearing, 1990; Balatsky & Diener, 1993). These are life satisfaction, positive affect, and negative affect. On the other hand, in the health care literature, a different consensus has emerged as to the important components and correlates of this gestalt (Spilker, 1990; Schipper & Levitt, 1985). Though terminology differs, the conceptual formulation which has emerged defines QOL functionally by patients' performance in four areas: physical and occupational function, psychological state, social interaction, and somatic sensation (Levine & Croog, 1985). Similarly, Alexander and Willems (1981) suggest that the most crucial domains of QOL are: physical well-being (or health), social relationships and activities, personal development, recreation, economic circumstances, and safety.

Flanagan (1978), using an inductive approach to establish the dimensions of QOL, classified 6500 critical incidents of positive and negative life experiences. The major domains identified included physical and material well-being; social relations; social, community and civic activities; personal development and fulfillment; and recreation. Flanagan (1982) determined that 15 scales would be necessary to assess an individual's QOL.

Subjective Well-Being

A promising operationalization of QOL is the notion of SWB (Andrews & Robinson, 1991). SWB is a global assessment or thoughtful appraisal of QOL as-a-whole or satisfaction with life in general (Argyle, 1987). While various psychological concepts such as self-esteem, mood, optimism, depression, hardiness, locus of control, or anxiety, influence subjective QOL, only SWB provides an overall evaluation of the individual's perception of QOL. The following definition of QOL reflects the salience of SWB.

> The secrets of well-being include having meaning and direction of life, having experienced problems and overcome them, using failure constructively, having already attained several long term goals, being pleased with personal growth and development, being in love, having friends, being cheerful, having no major fears, being neither thick skinned nor too sensitive to criticism (Sheehy, 1982).

The notion of a global QOL is more pronounced in the research approach adopted by Andrews and colleagues (Andrews, 1991; Andrews & Withey, 1976; McKennell & Andrews, 1980, 1983). These researchers have found that the most powerful predictors of global SWB are the reported satisfaction with a number of specific life domains. Generally, between 5 and 15 life concern assessments can account for 40-60% of the variance in evaluations of global subjective assessments of QOL. Andrews and Withey (1976) demonstrated that after allowing for correlated and random measurement error, virtually all of the potentially explainable variance in their global QOL measure could be explained by several different sets of life concern assessments. The implicit assumption underlying these analyses is that subjective evaluations of specific life concerns are somehow combined to form global QOL assessments.

However, Moller and Schlemmer (1989) argue that QOL is much more than the sum total of specific satisfactions. Their results suggest that overall SWB is a perception which stands apart from specific satisfactions in life domains. They postulate that symbolic images of life and personal morale play a substantial part in one's overall life satisfaction. Duncan (1984) argues that there is no fundamental solution to the problem of combining indicators until the system that generates them is correctly understood. The confusion may be a result of mistakenly combining life domain satisfactions to form an indicator of QOL when they should be considered as separate predictors of QOL.

An assumption in most social indicators research is that SWB is a relatively stable construct (Chamberlain, 1988; Headey & Wearing, 1989; Pavot & Diener, 1993; Chamberlain & Zika, 1992). If SWB were a transient response, it would make little sense to develop social policies based on such research (McNeil et al., 1986). Recent findings suggest that the facets of SWB are consistent across different cultures as well (Balatsky & Diener, 1993). The landmark research of Andrews and Withey (1976) and Campbell et al. (1976) were clearly predicated on the assumption that SWB is stable over time. This assumption has recently been made more explicit (Chamberlain & Zika, 1992).

Andrews (1991) found that the structure of SWB and how domain-specific life satisfactions predict global life satisfaction have been remarkably stable over a 16 year period in the United States. Diener and Larsen (1984) also provide empirical support for the assumption that SWB is stable. They found satisfaction with life to be the most stable concept both across time and across situations, among the several perceptions that they measured. While Yardley and Rice (1991) provide strong support for the proposition that SWB is stable over time, they also suggest that it is influenced by concurrent mood. However, SWB and mood may influence one another through a reciprocal, bi-directional causal relationship.

The distinction between affective and cognitive components of SWB has been examined (Andrews & McKennell, 1980; Campbell et al., 1976; Horley & Little, 1985; De Haes, Pennink & Welvaart, 1987). Using structural equation modeling, Andrews and McKennell (1980) developed models of SWB which included or omitted a cognitive component. Beginning with the assumption that measures of SWB are attitudes and that attitudes include affective and cognitive components, they sought to determine the extent to which each of 23 measures reflected affective, cognitive, and methodological components.

They found that the inclusion of a cognitive component improved the fit of the model but also suggested that measures would be better identified in terms of their affect-to-cognition ratios, rather than as pure measures of either dimension. For example, global satisfaction measures were found to contain considerable affective content. They proposed that both cognition and affect contribute to all subjective measures but that different measures (e.g., satisfaction versus happiness ratings) may be differentially sensitive to cognitive and affective components. These findings were replicated in a large Canadian sample, supporting the existence of a cognitive dimension in QOL evaluations (Horley & Little, 1985). It has also been suggested that people have access to information about their level of SWB which is stored in memory and that people search for, access, and report this information when they make reports of their SWB to others (Pavot & Diener, 1993).

McKennell (1978) suggested that the discrepancy between affect and cognition may increase in times of social change. Moreover, the affective component might be more responsive to personal concerns of the individual than to events in the political and social environment. De Haes et al. (1987) confirmed these assertions in a study of early breast cancer patients. They found that by lowering aspirations or by setting lower standards of comparison, cancer patients could restore their life satisfaction. They underscored the importance of assessing both affective and cognitive appraisals of QOL to gain insight to the consequences of changes perceived by the patient.

There is also substantial evidence that affective and cognitive dimensions of QOL have different correlates (Campbell et al., 1976; Michalos, 1986a). However, there is disagreement about how and if the conceptual boundaries between cognition and affect can be meaningfully distinguished (Wright, 1985b); Abbey and Andrews (1986) failing to support such a distinction at all. The correlates of affective and cognitive measures of QOL have not been extensively explored because of the lack of suitable measures of cognition.

Life Satisfaction

Conceptualizations of QOL have tended to focus on either life satisfaction or happiness, and often, both (Michalos, 1986b, 1991a, 1991b; Davis & Fine-Davis, 1991). Life satisfaction is one of the most widely known constructs in the social psychological and social indicators literature. Dalkey and Rourke (1973) offer a comprehensive definition of QOL as "a person's sense of well-being, his satisfaction or dissatisfaction with life, or his happiness or unhappiness" (p. 210). However, life satisfaction is thought by some to be conceptually distinct from happiness (Kozma, Stone, Stones, Hannah & McNeil, 1990). Others (Mason & Faulkenberry, 1978;

Michalos, 1980, 1983) suggest that satisfaction implies a cognitive experience while happiness reflects an affective experience.

Michalos (1980) supports a distinction between satisfaction and happiness in that while satisfaction and happiness consist of both cognitive and affective elements, satisfaction possesses more cognitive elements whereas happiness exhibits more affective elements. The work of Michalos (1980) supports the hypothesis that some life domains predict satisfaction better while others are more predictive of happiness. Those domains which are more closely associated with satisfaction tend to be more related to cognition and those domains which are more predictive of happiness tend to involve affect to a greater extent.

George (1979, 1990) defines life satisfaction as an assessment of the overall condition of a person's life, which is made by comparing one's aspirations to one's achievements. Campbell et al. (1976) used life satisfaction as the theoretical basis of their systematic study of the quality of American life. While Campbell et al. (1976) decided to use life satisfaction rather than happiness as a measure of QOL, they did include several indicators of happiness in their study. However, they suggested that the use of satisfaction is a better indicator of QOL because it implies a cognitive judgment of a situation in which internal standards are used for comparison.

Fox and Kahneman (1992), taking a constructionists view, believe that answers to SWB questions represent ad hoc constructions evoked by the questions and by circumstances of the moment. Responses are, therefore, outcomes of a cognitive process which involves interpretation, memory search, evaluation and editing. They further argue that life satisfaction is mainly determined by an explicit or implicit comparison of a current state to some reference standard.

In support of operationalizing QOL in terms of satisfaction, Campbell (1981) and Laborde and Powers (1980) have found that, when questioned about the quality of their lives, apparently healthy individuals respond in terms of life satisfaction, usually in relation to specific life domains. It is essential to recognize that satisfaction with particular domains can vary greatly between individuals and that for each individual the relative importance of domains vary over a life time (Ferrans & Powers, 1985).

Campbell et al. (1976) described a model that involved a global assessment of SWB as well as an assessment of satisfaction in several domains of life. Of the life domains studied, the respondents perceived the following as most important: health, marriage, family life, national government, friendships, housing, job, community, religious faith, non-work activities, financial situation, and organizations. Satisfaction with a specific domain, determined by the individual's evaluation of its attributes, in turn is dependent on perceptions, internal reference standards, judgment, and the discrepancy between aspiration and expectation. Noteworthy, is the fact that those life domains deemed most important to the respondents were not necessarily the domains perceived as most satisfying. In fact, Campbell et al. (1976) found that the respondents ranked the domains by importance less reliably than they rated their satisfaction with a particular domain.

Bharadwaj and Wilkening (1977) were surprised to find that satisfaction with health and family far outweighed the contribution of work satisfaction to life satisfaction. Davis and Fine-Davis (1991) found that satisfaction with health was more predictive of overall life satisfaction than either satisfaction with housing or neighbourhood. Others (McNeil et al., 1986) also found that health was the most powerful predictor of QOL but that it predicted at most only 15% of the variance in QOL. These domain satisfaction scores taken together explained 54% of the variance of the global measure of SWB (McNeil et al., 1986). The conclusion, supporting the work of Bharadwaj and Wilkening (1977), was that global reports of SWB meaningfully reflected a composite of feelings of satisfaction with a variety of specific life domains, despite the fact that a considerable proportion of variance was not accounted for in either study.

Andrews and Withey (1976) also developed a model of perceived QOL using a satisfaction approach in partial replication of the work of Campbell et al. (1976). They suggest that QOL can be described on two levels, the "global" level and the "concern" level. On the concern level, possible domains involving role situations, such as house, job, and family life are portrayed on one axis and criteria relating to values, such as success, beauty, and fun are illustrated on the other axis. Both domains and criteria or concerns were thought to reflect a global sense of well-being. This additive model explained 50 to 60% of the variance in an index of overall life quality.

Atkinson (1981, 1982) described QOL as a multidimensional concept which was measured by subjective reports of life satisfaction with various life domains. In a large Canadian sample, Atkinson found that objective measures of life events failed to influence self-reports of life satisfaction. Also, like others (Rodgers & Converse, 1975; Buttel, Wilkening, & Martinson, 1977; Horley & Little, 1985; Evans, Burns, Robinson, & Garrett, 1985; Larsen et al., 1985) he maintained that life satisfaction was a more stable measure of QOL than happiness, since happiness appeared to reflect an emotional state, whereas satisfaction implied a cognitive judgment of a situation based on personal comparisons.

Kennedy, Northcott, and Kinzel (1978) used an approach similar to that of Campbell et al. (1976) in their study of the quality of social life of Edmontonians in Canada. In addition to a measure of general satisfaction, they included measures relating to satisfaction with health, standard of living, family life, friendships, recreation, children's education, and pace of life. They were able to explain 45% of the variance in general satisfaction with the first five variables.

More recently, Oppong, Ironside, and Kennedy (1988) compared the QOL of Edmontonians to the residents of the High Prairie region of Northern Alberta within a centre-periphery framework. This model assumes an autonomy/dependency pattern of economic development, the core dominating the periphery. That is, the Edmonton-Calgary corridor represents the centre while the rest of the province, especially Northern Alberta, characterizes the periphery. Measures of satisfaction with housing, family life, health, leisure time, friendships, standard of living, and work were obtained. Contrary to what the centre-periphery framework dictates, they found that residents of High Prairie evaluated their lives as more satisfying than did Edmontonians. It appears that QOL is relative to one's personal standard, and what is perceived as beneficial by one person may not be perceived as such by another.

Just as satisfaction with domains of life varies between individuals, the importance of each domain also varies and does not impact equally on QOL (Campbell, 1981). Michalos (1986a), for example, found quite different domain satisfactions to be the best predictors of overall life satisfaction depending on the characteristics of the Canadian subjects. For clerical staff of a Canadian university, the most influential life domain was satisfaction with one's family relations, for rural seniors it was housing satisfaction, for northerners it was satisfaction with financial security, and for undergraduate university students it was satisfaction with personal self-esteem (Michalos, 1991b).

Headey, Holmstrom and Wearing (1985) provided convincing evidence that the determinants of well-being differed from the determinants of ill-being. Using structural equation modeling, their well-being model accounted for 80.8% of the variance in well-being. Demographic variables and social support factors influenced well-being only indirectly whereas domain satisfactions directly influenced well-being. Moreover, they found that two personality traits influenced both well-being and ill-being, namely, self-esteem and personal competence; others have reported similar findings (Waltz & Badura, 1988; Bryant & Veroff, 1986).

Specifically, people who possess a strong internal locus of control suffer less in the face of adversity due to a buffering effect (Headey & Wearing, 1990). Moreover, satisfaction with one's health has more impact on ill-being than well-being, and satisfaction with friends, leisure, and supportive networks have much more impact on well-being.

This means that ill-health, and the subsequent dissatisfaction with one's physical condition, can lead to feelings of anxiety and ill-being. However, people with good health and who are satisfied with their physical condition simply take it for granted.

Happiness

Happiness has been a central focus of philosophical thought over the centuries and it remains today a topic of personal concern and social significance (Fordyce, 1985; Kammann, Farry & Herbison, 1984; Stones & Kozma, 1991). Campbell (1976) suggests that happiness is a uniquely important component of the QOL experience and an indispensable psychological construct. However, happiness has been used less frequently than life satisfaction as an indicator of QOL. The long delay for psychology to seriously study happiness may be due to an ingrained, cultural perception of happiness as being too elusive, unexplainable, and subjective; thus unviable as a candidate for empirical measurement and study. As happiness research has developed over the last two decades to the state it has currently reached, the old views about the non-researchability of happiness have faded.

Many philosophers have sought to characterize QOL in terms of personal happiness (Holmes, 1989). Some have maintained that happiness is the only ultimate end in life which cannot in itself be justified but is, rather, intuitively perceived. For example, Aristotle identified happiness, in an ethical sense, as the chief and final good to be sought by human beings (Adler, 1985). However, happiness has been described and interpreted in many ways leaving the meaning of this concept unclear. Aristotle recognized the ambiguity inherent in the definition of happiness long ago:

> When it comes to saying in what happiness consists, opinions differ, and the account given by the generality of mankind is not at all like that of the wise. The former take it to be something obvious and familiar, like pleasure or money or eminence, and there are various other views, and often the same person actually changes his opinion. When he falls ill he says that it is his health, and when he is hard up he says that it is money (1976).

Happiness as a scientific construct has been viewed both as a disposition (Stones & Kozma, 1986a; 1986b) and as a temporary affective state (Bradburn & Caplovitz, 1965; Diener, 1984). A component model of happiness has been proposed which combines long-term and short-term affective states in the concept. Two age parameters, one for long-term and one for short-term affect, are added to the model to account for age changes in happiness (Kozma, Stone, Stones, Hannah & McNeil, 1990). More recently a sophisticated model of happiness has been developed which allows for personality and environmental influences (Stones & Kozma, 1991).

The model postulates that long- and short-term affective states combine additively to produce current happiness. The short-term components are thought to be more susceptible to environmental manipulation than the long-term ones and are predicted to change more readily with an experimental manipulation (Kozma, Di Fazio, Stones, & Hannah, 1992). Their data from 690 persons in three adult age groups revealed that an additive model based on long- and short-term affect, age, and sex, produced the best explanation for current happiness.

Happiness has also been identified with feelings of pleasure, that is, the transient emotional state of contentment and well-being. It has also been described as an assessment of the fulfillment of goals or needs. For example, McCall (1975) conceptualized QOL as the satisfaction of "general happiness requirements", a phrase that is never clearly defined. Gill (1984a, 1984b, 1984c) equated QOL with happiness and energy. He found that, in a community of urban Aucklanders, satisfaction with home, marriage, family, friends, work, and financial situation has little, if any, relationship to physical health but that well-being as seen through the domains of happiness and energy did. George (1981) noted that life satisfaction measures have a stable, global or long-term orientation in contrast to happiness which typically has a short-term referent.

The work of Bradburn (1969) has been widely cited in the QOL literature but not without criticism. Overall happiness is viewed as the balance between positive and negative experiences that have occurred in the past few weeks. Bradburn's (1969) Affective Balance Scale consists of two subscales: the Positive Affective Scale (PAS) and the Negative Affective Scale (NAS). Bradburn proposed that the dimensions of positive and negative affect were independent, a finding which was substantiated by subsequent studies (e.g., Andrews & Withey, 1976; Zevon & Tellegen, 1982) but challenged by others (Brenner, 1975; Kammann, Farry, & Herbison, 1984). Moreover, the PAS and the NAS have different correlates (Andrews & Withey, 1976; Bryant & Veroff, 1982).

Shin and Johnson (1978) described a comprehensive theory of happiness where happiness consists of: the possession of resources; the satisfaction of needs, wants, and desires; participation in self-actualizing activities; and comparisons with others and past experiences. Happiness is thought to be a product of the positive assessment of life situations and the favorable comparisons of these life situations with the situations of others and with past experiences. The various personal characteristics and the resources under an individual's command influence happiness mostly through their effects on the processes of assessment and comparison. Note that this definition of happiness could fit the definition of life satisfaction equally well. Again, the distinction is unclear.

Indeed, Michalos (1991a) suggests that there is little merit in attempts to draw fine distinctions between transient and stable aspects of SWB. Most research has shown that happiness and life satisfaction share common meaning (Michalos, 1991a; Argyle, 1987; Veenhoven, 1984). Satisfaction or happiness with one's life is generally perceived as a relatively lasting, positive perspective about one's life. Therefore, Michalos (1991a) believes that a theory of life satisfaction would be a theory of happiness, and in turn, such theories would be theories of SWB. However, because measures of happiness and life satisfaction do not have identical connotations or denotations, Michalos suggests analyzing their components separately.

Health-Related Quality of Life

The QOL paradigm is new in the health care literature and many conceptualizations of QOL are emerging. Indeed, it was not until 1977 that the term quality of life first received a separate heading in *Index Medicus* (Frank-Stromborg, 1988). Yet, the concept of QOL has moved forward as an ideological justification for health care (Cohen, 1982). Indeed, QOL is taking its place alongside mortality and morbidity as a major criterion in the evaluation of medical interventions (Levine, Croog, & Sudilovsky, 1985; Wenger, 1993).

With few exceptions, conceptualizations of QOL in health care research differ from those in social science research. The interpretations of the meaning of QOL in the health care literature reveal considerable confusion, divergence, and even contradiction. Consequently, QOL measurement has been inconsistent, simplistic, and of questionable relevance to the QOL construct and little progress toward the development of a theory of QOL has been achieved.

According to Gilbar (1991) the important components of QOL include psychological distress, social interactions, and functional status. Others believe the relevant dimensions of QOL include emotional, physical, and social functioning (Lim et al., 1993). Additional factors considered for QOL assessment include sexuality, body image, and satisfaction with medical care. Spitzer et al. (1981) include physical, social and emotional functioning, attitudes toward illness, family interactions, and the cost of illness in their definition of QOL. George and Bearon (1980) defined QOL in terms of life satisfaction, self-esteem, general health and functional status, and socioeconomic status.

The general lack of consensus among health care researchers regarding the distinct domains and defining criteria of health and QOL permit only the most limited conclusions about a patient's overall QOL. There remains considerable inconsistency and confusion regarding whether or not health is truly a dimension of QOL or rather a strong causal predictor of QOL. In spite of an agreement on the importance of physical, emotional and social well-being, and functional capacity, the components identified are not embedded in a conceptual model and they appear be indicators of the health construct as opposed to the QOL construct. In addition, some of these components may be universal, others culture-specific.

Shaw (1977) mathematically conceptualized QOL as QL=NE x (H+S), where QL represents QOL, NE represents the patient's natural endowment (physical and intellectual), H represents contributions of the individual's home and family, and S represents contributions of society. Thus, an individual who is either environmentally deprived or lacking natural endowment could theoretically possess a QOL approaching zero. Nonetheless, Shaw appears to view these various contributions to QOL as just that, predictors rather than indicators.

Normality is a concept prized in Canadian culture and gives a positive connotation to the phrase quality of life (Edlund & Tancredi, 1985). In the medical community, the concept of reintegration to normal living has been proposed as a proxy for QOL (Wood & Williams, 1987). This refers to a reorganization of the physical, psychological, and social characteristics of an individual into a harmonious whole, so that well-adjusted living can be resumed after an incapacitating illness. Though plausible, the idea of QOL as meaning a normal life is impossible to define. It potentially possesses as many definitions as there are members of the population.

The idea of QOL as the ability to lead a socially useful life also possesses a multitude of potential meanings. One social utility view values individuals only for their productivity (Grabowski & Hansen, 1990). To some policymakers, a social utility definition of QOL may mean that one is gainfully employed and contributing to the national economy.

Most defenders of a utility measure agree that productivity is not the only valuable measure of change in an individual's well-being but they do claim that it is important. Although QOL certainly implies more than workplace activity, work remains one of the major human activities, and the impact of disease on work will be reflected in other aspects of an individual's life. However, given that QOL in health care is often considered with reference to the retired, elderly, or chronically ill, it is clear that employment is a very narrow definition of social utility, and not an adequate definition of QOL at all. Many individuals, while not active in the work force are, nevertheless, productive in household or community activities.

Many researchers consider health an ultimate end in itself and others consider it a prerequisite to the pursuit of personal happiness or QOL or some other ultimate end. However, such beliefs have been found to be quite erroneous; it would appear that while some individuals certainly struggle to achieve their ends in spite of ill-health, others achieve them through, or because of, their ill-health

(Holmes, 1989; Siegel, 1993). This way of conceiving ill-health as a process which can become a positive life experience rather than as an entity with just negative consequences raises fundamental concerns regarding the conceptualization and evaluation of QOL only in terms of health status.

A recent and disturbing conceptual shift has taken place in the health care literature. The phrase quality of life is being replaced with health-related quality of life (HRQOL). The conceptualizations of QOL by social scientists is thought by many health care researchers to be too broad, embracing a multitude of factors such as happiness, life satisfaction, or SWB considered to be uninfluenced by or insensitive to health-care interventions and of little use for evaluating medical interventions (Kaplan & Anderson, 1990; Patrick & Erickson, 1993). Equally disturbing, a medical sociologist advocates distinguishing between "quality of life aspects which are health-related from the QOL which resides in the basic social conditions of our larger world" (Levine, 1987, p. 14). Guyatt (1993) favors the term HRQOL because many aspects of life are not considered as "health-related" including income, freedom and quality of the environment because these problems are often distant from a health or medical concern. The conceptualization of QOL in terms of health or physiological function appears to be indicative of a simplistic solution to the difficult struggle in defining

QOL and a consequent avoidance of the task of developing a coherent theory.

The justification for this new concept label, HRQOL, is that it more accurately reflects the impact of disease conditions on function. Patrick & Erickson (1993) define HRQOL as "the value assigned to duration of life as modified by the impairments, functional states, perceptions, and social opportunities that are influenced by disease, injury, treatment, or policy" (p. 22). However, others argue that health status measures are too narrow in scope and omit the patient's subjective perceptions (Guyatt, Patrick & Feeny, 1991). The movement towards a narrow, disease oriented approach to QOL assessment is inappropriate and raises the question of whether QOL or health status is being measured. Unfortunately, the term HRQOL has caught the imagination of clinicians and researchers and has become well entrenched. On the other hand, at least one physician considers the term HRQOL as cumbersome (Fries, 1991). He suggests that "health" contains the information and that "the jargon has added 'related' and 'of life' and even the perjorative 'quality'" (p. 107S).

Those who object to the use of quality of life in health care research maintain that the quality of a person's life has determinants in which those measuring the effect of a treatment in a clinical trial may be only peripherally interested (Guyatt, Feeny & Patrick, 1991). Such aspects include social relationships, cultural activities, and meaningful work. Further, it is argued that many aspects in which the clinical researcher may be directly interested (such as the extent to which patients with chronic disease are functionally limited) are only indirectly related to QOL, which can be viewed as a totally subjective internal experience.

The advocates of the label HRQOL argue that the very term QOL suggests something highly subjective and immeasurable that can only generate "soft data" unworthy of serious scientific medical research. Perhaps researchers ought to beware of being too altruistic in considering the development of HRQOL measures in clinical trials. The current enthusiasm for HRQOL may be tinged with an inevitable degree of self-interest on the part of the investigators and sponsors of clinical trials who may believe that the inclusion of HRQOL assessments will be advantageous for the image of the trial.

The trouble with the label HRQOL is that some of the vital factors on which QOL depends are completely neglected. Redefining QOL as HRQOL may have greatly simplified clinical research but it has failed to add clarity to the concept of subjective QOL. Bowling (1991) maintains that health and functional status are just two dimensions of QOL. It is argued herein that health is not a dimension of QOL but rather a predictor of QOL. The term HRQOL only adds to the conceptual confusion between health and a more global definition of QOL. While there is considerable evidence that health and QOL are causally related, they are distinct concepts and combining them conceptually threatens the validity of the interpretations of the measures of both constructs.

The fusion of the concept of health and the broader concept of QOL can be explained by the advent of comprehensive definitions of health (Ware, 1987). While health was once defined primarily in terms of mortality and the extent of disease, the emerging conceptualization of health is far broader. Ware conceptualizes health in terms of physical health, mental health, social functioning, role functioning, and general well-being. To distinguish the new conceptualization of health from the old, the term HRQOL has been adopted.

However, most definitions of health are not as comprehensive as that offered by Ware and it is currently fashionable to equate all health-related data to HRQOL and everything else to QOL. The consequence of broadening the definition of health and then labeling it HRQOL or of eliminating fundamental indicators of QOL (because they are deemed irrelevant to the clinical study) and then asserting that QOL is being assessed, is that the boundaries of both constructs are no longer well-defined. Health ought to be measured as a construct separate and distinct from the much more encompassing QOL construct. To do otherwise leads to uninterpretable results.

These objections to the use of the term QOL in reference to assessments of physical functioning and to the idiosyncratic definitions of the term HRQOL have not stopped both from being widely adopted and frequently used. To illustrate the confusion (often unrecognized by the researchers) between the nature of the concepts of health and QOL, a group of researchers stated that in their study "The term quality of life is used synonymously with health" (Churchill, Morgan, & Torrance, 1984, p. 20). Moreover, Guyatt (1993) asserts that health status, functional status, and QOL are three concepts often used interchangeably to refer to the same domain of health. Others simply state the purpose of their study as an investigation of QOL and then proceed to operationalize QOL with a health measure (Rosenblum, Rosen, Pine, Rosen & Borg-Stein, 1993). Clinical research appears not to have profited from the work of the social scientists (Bullinger & Hasford, 1991).

Bliley and Ferrans (1993), in a study of patients undergoing percutaneous transluminal coronary angioplasty (PTCA), are among the few researchers who attempt to determine the relationship between measures of both QOL and HRQOL. However, they fail to differentiate between the concepts of health and HRQOL. These researchers conceptualized QOL as a construct that has four major domains: health and functioning, social and economic, psychological/spiritual, and family. Overall QOL and the four life domains define perceived QOL. QOL is one's sense of well-being that stems from satisfaction or dissatisfaction with the areas of life that are important to the person.

HRQOL, while not defined, is measured by cardiac symptoms, tolerance of physical activity, exercise capacity, perceived general health, return to work, and lifestyle changes. All but perceptions of general health are objective measures of health. Not surprising, before PTCA, the only significant predictor of overall perceived QOL was perceived health - the only subjective measure, which accounted for 40% of the variance in QOL. After PTCA, besides perceived health, fatigue and ability to perform activity without cardiac symptoms significantly determined perceived QOL, accounting for only 6% more of the variance in QOL.

The application of the QOL concept to therapeutic studies is recent, measures developed in nonclinical disciplines have not been recognized, great skepticism is voiced concerning the measurement of QOL, and the term QOL is often conceived of as a subjective phenomenon to which any scientific approach appears fruitless. Thus, the term HRQOL has permitted health care researchers to avoid the difficulty of defining, conceptualizing, and measuring the QOL construct and instead they have substituted available health measures for QOL measures and simply attached a new concept label.

Promising Conceptual Efforts

A review of the current literature on QOL reveals that the majority of QOL studies, particularly in the health care literature, lack disciplined guidance of a conceptual framework. However, a number of psychological, sociological, and biological theories have been used to study happiness and SWB. Diener (1984) provides a comprehensive discussion, from a psychological perspective, of several types of theories which have been used implicitly in the study of QOL.

In telic or endpoint theories, happiness is gained when some state, such as a goal is attained. In pleasure or pain theories an individual's goal or needs relate to what is missing in that person's life. The assumption in this approach is that the greater the deprivation, and hence the unhappiness, the greater the joy upon achieving the goal. Whereas telic theories place the locus of happiness in certain end states, activity theories maintain that happiness is a by-product of social activity (e.g., Aristotle). Associationistic theories seek to explain why some individuals have a personality that predisposes them to happiness, and judgment theories postulate that happiness results from a comparison between some standard and actual condition (Eiser, 1990; Michalos, 1991a).

In a bottom-up theory, happiness is deemed to result from the sum of many small pleasures. Similarly, a bottom-up theory holds that life domain satisfactions combine to account for perceived QOL (Headey, Glowacki, Holmstrom & Wearing, 1985). Conversely, the top-down approach assumes that there is a global propensity to experience situations in a positive way. That is, domain satisfactions reflect an overall level of SWB which is determined by relatively stable personality traits. Influenced by the Michigan researchers (Andrews & Withey, 1976; Campbell et al., 1976), most investigators appear, implicitly, to accept a bottom-up theory. More precisely, most researchers have assumed that a linear additive combination of domain satisfactions accounts for SWB (Andrews & Withey, 1976; Campbell et al., 1976). That is, the whole is the sum of the parts; satisfaction with life is simply a sum of the various domain specific satisfactions. However, perhaps satisfaction with life domains result from, rather than, cause global life satisfaction.

Indeed, one of the most fundamental problems in research on subjective QOL is the uncertainty about which variables cause SWB and which are consequences. Headey, Veenhoven, and Wearing (1991) have proposed a statistical model which holds promise of resolving issues of causal direction. The purpose of the model is to estimate the reciprocal net effects between a number of variables and SWB. In contrast, Diener (1984) notes that high inter-correlations among domain satisfactions could be taken as evidence for a top-down model. The correlations suggests that domain satisfactions could be just a spin-off from overall levels of life satisfaction. A third possibility, implied by Costa and McCrae (1980), is that apparent causal relationships between domain satisfactions and measures of SWB are spurious, with both sets of variables being dependent on stable personality traits, notably extroversion and neuroticism.

Using data drawn from 4 waves of an Australian Quality of Life panel survey (1981-1987), Headey et al. (1991) assessed the causal direction between domain satisfactions (marriage, work, leisure, standard of living, and health) and SWB. The researchers present results contrary to conventional wisdom. The marriage domain was characterized by two-way causation and the work, leisure, and standard of living domains showed top-down causation. The observed correlations between life satisfaction, and both friendship and health satisfaction appeared to be spurious, with extroversion and neuroticism being related to both.

Zautra and Goodhart (1979) describe 4 theoretical perspectives of psychological well-being that have been used to study QOL: epidemiological models, life-crisis models, competency models, and adaptation-level models. The focus of the epidemiological model is the distribution of QOL in the population and the factors in people's lives that increase the probability of QOL. The life crisis model is based on the notion that outcomes other than illness may result from major life experiences. The competency models regard QOL as arising from experiences of self-mastery, efficiency, and competency.

Finally, the adaptation-level model is based on the view that people evaluate life experiences by comparing them to previous personal experience and to other individuals.

Phenomenology is another approach that has been proposed as a method of developing a theory of QOL (Schuessler & Fisher, 1985) and it is argued that subjective QOL can only be described in terms of personal meaning (Glaser & Strauss, 1967; Strauss & Corbin, 1990). In Ziller's (1974) phenomenological theory, for example, QOL is inherent in self-appraisal, which in turn, is inherent in one's interactions with friends and family. The important outcome is self-regard rather than happiness or satisfaction.

Hermeneutics, the study of the person in context, also offers a way of understanding the phenomenal realm of health and illness (Benner, 1984, 1985). Benner (1984) asserts that QOL can be approached from the perspective of quality of being rather than merely from the perspective of doing and achieving. Hermeneutics phenomenology is holistic in that it seeks to study the person in the situation, rather than isolating person variables and situation variables and then trying to put them together (Lazarus & Launier, 1978). The participant offers a depiction of the lived experience and the interpreter seeks communalities in meaning. The goal is to achieve understanding and to generate a theory (Benner, 1985). A unified theory of QOL, regardless of the method of construction, would benefit both patients and caregivers by providing a common criteria for evaluating the effectiveness of treatment.

Recently, systems theory has been the basis for the construction of the Quality of Life Systemic Inventory (QLSI) (Duquette, Dupuis, & Perrault, 1994). The four key concepts are: goals, control, feedback loops, and hierarchy. It is assumed that behaviors are controlled and directed toward goals. Further, actions are performed to attain or maintain a desired state and thereby reduce the gaps between the present state and the goals set. A negative feedback loop results when there is an effective reduction in the gap between the state and the goal. A positive feedback loop results when the gap between the state and the goal increases. Finally, goal priorities are established in a hierarchy which can cause conflict when one is faced with too many priorities or when equally important goals are set. Therefore, QOL corresponds to the distance between the states and goals of an individual in different hierarchically organized life domains.

Unlike some, these researchers do not distinquish between happiness/satisfaction and achievement of goals. In the Aristotelian philosophy, happiness is deemed the ultimate goal. However, these researchers consider happiness as a long term goal and not the short term positive feeling that is closer to the notion of pleasure. Evaluating personal goals indicate the gap between the actual state and the personal goal. The gap gives the degree of happiness reached by the patient. The dynamics of the patient's condition is then assessed on a speed dial resembling a speedometer with improvement at the left of the dial and deterioration to the right. Finally, priorities are identified on a 7-point likert scale. A low priority life domain may not have much effect on overall QOL whereas changes in an essential sphere will have a greater impact. Both the dynamics (speed dial) and the rank scores are used to weight the gap score. The final weighted gap score corresponds to QOL.

The authors offer a number of advantages of the QLSI. First, they suggest that it offers an operational definition of QOL based on a process (pursuit of goals) which transcends dimensions and reintroduces the concept of happiness in each of them. More importantly, they recognize that it makes the distinction between QOL and moods or psychological conditions which most QOL research fails to do. While psychological assessments may be necessary this must not be confused as a QOL assessment. The same argument applies to measures of health, functional ability, or social functioning. These concepts are not equivalent to QOL. They may influence or predict QOL to varying degrees, depending on an individual's goals and priorities, but they are not indicators of QOL. The researchers correctly point out that there exists many psychometrically sound instruments to capture these other concepts but they should not be considered a QOL assessment.

Finally, the QLSI is a personalized evaluation and the different life domains are not attributed equal value. Individuals rank the items from a personal perspective.

An area of research with significant potential for explaining how subjective QOL is derived is the gap or ratio approach to understanding SWB (Inglehart & Rabier, 1986; Andrews & Robinson, 1991). The origins of the gap/ratio conceptual perspective go back to the Michigan researchers (Andrews & Withey, 1976; Campbell et al., 1976). The hypothesis that overall life satisfaction is a function of the perceived discrepancy between what one has and the best previous experience one has had was discussed by Campbell et al. (1976). Also, the hypothesis that overall satisfaction is a function of the perceived discrepancy between what one has and expected to have was explored by Festinger (1957). Festinger's theory of cognitive dissonance combined several kinds of discrepancies together, although the gap between expected and actual states of affairs was emphasized. Support for this hypothesis has been reported (Campbell et al., 1976; Michalos, 1985).

It is hypothesized that attitudes about subjective QOL reflect a gap between what people aspire to and what they perceive themselves as having (Andrews, 1981; Andrews & Withey, 1976; Campbell et al., 1976; Michalos, 1985, 1986b; Meadow et al., 1992). The gap is the difference between the aspired level and the achieved level. It is presumed that aspirations will usually be higher than perceived achievements, and that the smaller the difference the higher will be SWB. Negative differences, such as when perceived achievements exceed aspirations, are also presumed to produce high levels of SWB. The following definitions of QOL emphasize the individuals' own perception of the gap between what can be achieved and what cannot.

> To understand how people assess their life quality one has to focus on the hypothesized "gap" between what people have and what they aspire to. The key notion is that people whose actual life conditions and aspirations are closely matched will assess their life quality as much higher than will people for whom there is a large gap between actuality and aspiration (Abbey & Andrews, 1986, p. 86).

> Quality of life is measured by the degree to which an individual succeeds in accomplishing his desires, despite the constraints put upon him by a hostile or indifferent nature, God or social order (Gerson, 1976).

> Happiness occurs when self space and life space come closer (De Bono, 1979).

Recently, a theoretical notion of life satisfaction drawn from a judgment-type theory has been explored (Meadow et al., 1992). Life satisfaction is seen as a function of a cognitive comparison between perceived life accomplishments and a set of standards. These standards are classified according to their sources (e.g., the life accomplishments of relatives, friends, past experience, self-concept of strengths and weaknesses) and different forms (e.g., standards based on ideal, expected, deserved, minimum tolerable, and predicted outcomes). Overall life satisfaction, therefore, is an aggregate function of a set of life satisfaction states generated by evaluation of life accomplishments.

Meadow and colleagues (1992) conducted 2 studies using samples of 752 and 529 elderly respondents from Atlanta and Virginia, respectively. Life satisfaction was found to be significantly positively correlated with cognitive age, income, employment, education, marital status, social contact, activity, religiosity, morale, television viewership, and self-rated health. On the other hand, age, gender, and parenthood was not correlated with life satisfaction.

In a study of 589 residents of a rural community in northern Ontario, Michalos (1983) was able to account for 53% of the variance in ratings of global life satisfaction and 36% of the variance in global happiness in terms of satisfaction in 12 domains plus 7 demographic variables. The domain satisfaction variables tended to provide more explanatory power at the individual level (health, self-esteem, financial security) than did the demographic variables. Consistent with previous research, Michalos (1986b) found that demographic variables accounted for only about 10% of the variance in reported net satisfaction. More importantly, the gap-theoretic variables provided a simpler and stronger explanatory account than the 19 variables of satisfaction and happiness. Thus, the domain-to-satisfaction and happiness accounts can be usefully combined with the gap-theoretic accounts to provide a comprehensive analysis of the psychological dynamics involved in judgments of satisfaction and happiness.

Michalos has recently completed a formidable project where the satisfaction and happiness of 18,000 university undergraduates in 39 countries were explored. The aims of the project were to test the strength of the MDT in a variety of cultural settings, and to determine its strength in explaining global satisfaction and happiness, as well as satisfaction in 12 life domains. The 12 domains included health, finances, family relations, paid employment, friendships, housing, living partner, recreation activity, religion, self-esteem, transportation, and education.

Michalos reported that for this sample of university students, 8 demographic variables accounted for only 1% of the variance in life satisfaction and happiness scores (Michalos, 1991a). The top 3 predictors of life satisfaction scores were satisfaction with one's self-esteem, education, and finances, while the top three predictors of happiness scores were satisfaction with one's living partner, self-esteem and finances tied, and friendships. As previously demonstrated (Michalos, 1983), a tendency for interpersonal relations to be more influential for happiness than for life satisfaction was found (Michalos, 1991a).

Quality of Life of CABG Surgical Patients

In recent years, QOL has received increasing attention in the field of health care. In a period of spectacular advances in medical technology, questions arise as to whether these interventions enhance the QOL of the recipients (Walter, Mohan & Dahan-Mizrahl, 1992). Understanding the effects of CABG surgery on the patient's QOL is particularly important since the surgery may not significantly prolong life in some groups of patients compared with standard medical treatment.

To lend coherency to the current state of knowledge about QOL after CABG surgery, the studies included in this review were categorized according to the common characteristics or dominant paradigms implicit in the methodological approach or ideology of the investigators (see Appendix B). The papers reviewed here consisted of empirically-based studies in which an explicit attempt was made to define or measure QOL after CABG surgery (see Appendix C). The principal investigators of the 18 studies meeting the inclusion criteria included 3 psychiatrists and 4 medical professionals. Four studies were conducted collaboratively between medical and allied health care disciplines, 6 were conducted by nurses and, 1 was the product of a group of psychologists. The paradigms which emerged include the psychiatric paradigm, the medical paradigm, and the well-being paradigm.

The Psychiatric Paradigm

The most common approach to the measurement of the QOL after CABG prior to the 1980s has been that of psychiatric observation and diagnosis. Using semi-structure psychiatric interviews, a group of researchers followed the postoperative psychological and behavioral courses of 100 patients for 4 1/2 years after CABG surgery (Kornfeld, Heller, Frank, Wilson, & Malm, 1982). To supplement the psychiatric assessment, the Cattell 16 Personality Factor Questionnaire (Cattell & Eber, 1962) was administered along with a measure of type A behavior. After 3 1/2 years, 60% of patients were extremely pleased that they had undergone surgery, 50% were pain free, and 65% were employed, two-thirds of whom reported improved satisfaction with work. By 4 1/2 years, 23 patients had died and 16% had undergone repeat CABG surgery.

Before CABG surgery, 67% of the patients were sexually active at least once a week. By 9 months postoperatively, only 38% were, and 31% reported no sexual activity. The frequency of sexual activity correlated with preoperative cardiac impairment, return to work, and preoperative and postoperative measures of type A behavior. At 3 1/2 years postoperatively overall pleasure in life had improved substantially, with reduced nervousness, improved mood, and improved job, family, and sexual satisfaction. Pleasure in life improved in most patients (77%) and sexual satisfaction in fewest. Family relations were worse for 4% of patients.

When behavioral risk factors were explored at 3 1/2 years, most patients had complied with instructions to stop smoking while only 22% had followed the advice to reduce their weight. Of those advised to change their exercise patterns, 38% had done so. Most of the patients who demonstrated extreme type A behavior preoperatively remained so postoperatively. Postoperative angina was correlated with persistence of type A behavior traits. The results of the personality assessment were not discussed. However, the overall conclusion was that CABG led to substantial improvements in overall QOL including general pleasure, reduction of anxiety and depression, and improvement in job satisfaction and family relations.

In Alabama, a group of psychiatrists (Folks, Blake, Fleece, Sokol, & Freeman, 1986) evaluated the QOL of 96 CABG patients. QOL was operationalized using the Psychological Adjustment to Illness Scale (PAIS) (Derogatis, 1983). This 45 item scale was completed before and six months after surgery. Patients demonstrated significant improvements on four of the "quality of life" subscales of the PAIS, no change on two subscales, and a decline on one. While performance and frequency of sexual contact improved postoperatively, satisfaction with sexual function and the marital relationship was unchanged from before surgery.

Six months after surgery, scores on the PAIS vocational subscale indicated that illness interfered less with work, absenteeism had dropped, and physical performance had improved. Family relationships were reportedly strengthened and social activities had increased. Psychological distress scores were unchanged from the preoperative values although increased age was associated with less psychological distress. The health concerns subscale scores declined; this decline was likely a reflection of patients' unrealistic preoperative expectations. Many patients expected a returned to normal health or 100% functioning following surgery. The high expectations of younger patients for a full recovery also produced more psychological stress after surgery compared to older patients.

More recently, investigators have taken a broader view of QOL. British psychiatrists (Mayou & Bryant, 1987; Bryant & Mayou, 1989) examined the objective and subjective aspects of mental state and daily life which were thought to be important to a group of 79 men both before, and at 3 and 12 months after CABG surgery. The researchers measured what was considered to be the various dimensions of QOL including leisure, social life, psychological and psychiatric states, satisfaction with work, family relationships, and subjective expectations. Measures of mood and intelligence were also obtained.

Preoperatively, a high prevalence of psychiatric disorders, physical activity restrictions, and severe angina was found. There was little association between any measure of physical functioning, and social or mental functioning. By 3 months after surgery, most patients were very pleased with their progress. Only 25% of patients were dissatisfied with their level of physical activity, 22% were dissatisfied with their work, and 21% were dissatisfied with their sexual relationships.

One year after surgery, most men had no physical limitations even though 25% of patients were experiencing atypical chest pain. Overall mental state had not significantly changed although tension and anxiety were less evident and physical vigor was improved. Those who had been depressed preoperatively remained so postoperatively. Two new cases of mixed anxiety and depression were diagnosed. For most, cognitive functioning was marginally better but for 11 men it was substantially worse.

Although 15 patients were retired after surgery, 56% of the patients (N=40) had returned to work by one year after surgery. Of those working, 20% were very dissatisfied, usually because they had been switched to less interesting, and often financially less lucrative work. Only a third of the men were more pleased with their work situation than before surgery.

When asked if surgery had met their expectations, 9% of patients were quite dissatisfied and 14% were moderately dissatisfied with their general level of recovery. Even those experiencing little physical improvement believed that the surgery had been worthwhile. However, 5 of the men who were pleased with their recovery, were nonetheless, unable to effectively channel their increased vigor in a job or an intimate relationship. In general, patients' expectations were realized but some were unable to do as much as they had expected. Of the men who preoperatively predicted that they would be working in a year, 16 were not.

Many patients severely handicapped by angina subjectively reported an excellent outcome. Some of the men resumed a much fuller life, but many who described few objective life changes were still pleased to be free of the constant worry of angina and the need to pace themselves physically. These positive feelings of improvement are arguably as important as improvements in physical activities.

A large group of men did not benefit to the extent that would be expected from successful surgery. For these patients, a poor social outcome was associated with somatic symptoms and lack of confidence about physical activity which appeared to be due to anxiety rather than any physical cause. The authors concluded that although the changes in QOL were less impressive than doctors often expect, they seemed to meet the patients' expectations. A minority of patients expressed an unsatisfactory outcome, with a QOL even worse than before surgery. The investigators suggested that patients with major psychiatric symptoms before surgery would not likely benefit fully from CABG surgery.

The Medical Paradigm

The investigators in this paradigm tended to use objective measures of physical health to evaluate QOL after CABG surgery. Functional health status and the ability to return to work were emphasized and psychiatric diagnosis, psychological assessment, and reports of SWB were minimized.

One of the first studies of QOL to question the validity of employment status as an adequate QOL indicator for CABG patients was conducted in Pittsburgh (LaMendola and Pellegrini, 1979). To their credit, these researchers offered an explicit definition of QOL; however, QOL was not measured. QOL was defined as the individual's achievement of a satisfactory social situation within the limits of perceived physical capacity. Using a structured interview questionnaire, administered by telephone, a random sample of 95 CABG patients were assessed in terms of work status, job satisfaction, the desire to work, social support, and perceived physical limitations. The patients were interviewed between 6 and 37 months post-CABG surgery.

The researchers found that, of the 57 patients who wanted to work preoperatively, 79% were employed. Of 31 patients who did not want to work, 97% were retired, and 1 patient was unemployed. Moreover, 38 (88%) of those who had no perceived physical limits had a desire to work and were employed. Those with no desire to work were almost equally divided between those who had no perceived physical limits and those who had some perceived physical limits; however, almost all of these persons (N=29) had retired. The large number of patients who perceived no physical limits was thought to reflect the patients' high overall satisfaction with the results of surgery.

A significant finding was that those who valued either physical activity or social relationships rather than rest in the recovery period were more likely to perceive themselves as having no physical limits. Further, the spouse was most frequently named as the individual who was most helpful in the recovery period.

The researchers concluded that while the patients' perceptions of their physical limitations has a strong influence on their desire to work, work status was a very limited notion by which to assess productivity. CABG surgery did not increase employment; instead, employment fell for all age groups. Even though patients tended to retire after surgery, they were highly satisfied and felt physically unlimited. While the researchers concluded that the patients demonstrated an improved QOL, which was not measurable by work status, it is not clear how the improved QOL was demonstrated.

A group of researchers in Wisconsin investigated the changes in non-work activities of 350 CABG patients one year after surgery (Barboriak, Anderson & Rimm, 1983). QOL was operationally defined as non-occupationally oriented activities, hobbies, and recreational activities as measured by the Milwaukee Cardiovascular Quality of Life Inventory (Rimm, Hartz, Kalbfleisch, Anderson & Hoffmann, 1980). The most significant change observed was an 82% increase, over the preoperative values, in light physical activities such as walking or hiking. The time spend on moderately demanding activities such as golfing and bowling increased 33%. The patients also reported increased activities around the home, increased social activities outside the home, and a significant increase in the frequency of vacations. Patients also engaged in more self-education activities or part-time employment. No significant difference in the frequency of sexual activity or in the need for sleep was found.

One year after CABG surgery, patients significantly increased their activity in 5 of 10 categories of avocational activities and reported no change in the remaining five. This increased participation in self-improvement activities and in activities of light to moderate intensity was thought to be due to the decrease in angina. Given that the statistical analysis was not discussed and that this group was not compared to a control group, the researchers may have overstated the claim that CABG surgery was associated with an improvement in several variables linked with physical rehabilitation.

Researchers in 4 university medical centers in Boston, New York, and Worchester conducted one of the most comprehensive evaluations of the benefits of CABG surgery (Jenkins, Stanton, Savageau, Denlinger, & Klein, 1983). They selected a large number of instruments to measure the biomedical, physical, emotional, role, psychoneurological, attitudinal, interpersonal, occupational, and economic aspects of life of 318 patients before, and 6 months after surgery. A major research goal was to determine the important indicators of QOL.

The first postoperative month was reported as especially difficult for 43% of patients. Sadness, crying, or depression was reported by 40% of patients and 38% of patients expressed feeling anxious, worried, or afraid. Their physical recovery in the first 6 months was better than they had anticipated. However, 71% of patients engaged in only mild exercise. By the 6 month follow-up only 3% of patients were unable to carry out usual activities and 61% of patients reported no cardiac symptoms. Fifty-six percent of patients recovered better than they had expected, 32% were the same as before surgery, and only 12% were worse.

Only 5% of the group showed substantial declines in cognitive functioning at 6 months. There were some improvements in speed and concentration due to lower anxiety and depression and consuming fewer medications. Psychologically, 43% of patients reported doing better than expected, 45% the same, and 12% worse than before surgery. Of the 47 patients who were dissatisfied with the recovery progress, 32% cited physical status as the reason, 23% cited psychological reasons, and 34% didn't know. The health team was blamed by 9% of patients. A full 38% had been told they had become sensitive or touchy about trivial events.

Of the 69% of patients who had been employed preoperatively, 75% were employed at the 6 month follow-up. Problems in returning to work were encountered by 26% of the 165 patients who were employed after surgery. Of the 123 patients not working preoperatively, 49% thought they would not be able to return to work, 28% expected they could, and the rest were uncertain. Reasons for the inability to work included physical or emotional problems, the advice of the physician, forced retirement, and no job to return to.

Half of the patients reported that their surgery had brought their families closer together whereas 3% thought it had pulled them apart. Families were perceived as providing adequate affection by 81% of patients, and 74% felt understood by them whereas 36% felt overprotected and 5% thought family expectations were too high. Half of the patients reported no change in satisfaction with their sexual lives and for those who were more satisfied, improved energy level was given as the reason. Ten subscales of the Profile of Mood States (POMS) (McNair, Lorr, & Droppleman, 1971) were administered 6 months after surgery to measure aspects of QOL. The scores indicated that the level of depression had decreased, fatigue had diminished somewhat, the degree of vigor had risen dramatically, and the level of hostility had remained unchanged. The level of anxiety also decreased. However, levels of self-esteem or a sense of mastery were unchanged from preoperative levels.

Satisfaction with social life, family interactions, marriage and sexual functioning were similar before and after surgery. The investigators admitted that these changes may be a reflection of either a regression to the mean or the elevated psychological stress experienced immediately preoperatively. By the 6 month follow-up, most patients appeared to have experienced substantial relief of physical and psychological symptoms, restored physical and social function, return to work, and an enhanced QOL after CABG surgery. When asked if they would undergo surgery again, 71% gave an unqualified yes, 21% said it would depend on the factors involved, and 8% said no.

A group of researchers in 2 Sydney hospitals explored the psychological and social functioning of 89 patients before and 12 months after CABG surgery (Langeluddeck, Fulcher, Baird, Hughes, & Tennant, 1989). The PAIS was the instrument used to measure QOL. The PAIS scores indicated a high level of psychosocial impairment two days before surgery. There was general improvement in psychological symptoms over the first 6 months after surgery but little further improvement up to 1 year. Preoperative scores on the Centre for Epidemiological Studies Depression Scale (CESD)

(Radloff, 1977) suggested high levels of depression. On average, depression was significantly reduce at 6 months and this improvement was maintained but not furthered at 12 months. The preoperative rate of anxiety fell from 30% preoperatively to 18% at 6 and 12 months postoperatively. The PAIS psychological distress score was also significantly improved postoperatively.

Substantial improvement occurred in most areas of social functioning after surgery. For the 55% of patients who were employed prior to surgery, work functioning showed a dramatic improvement over the 6 month follow-up period; these improvements were maintained at the 12 month assessment. Of the individuals who were employed full-time preoperatively, 10% retired by one year with forced or unplanned retirement in only 4%. Improvements in domestic functioning postoperatively were considerable, which was important given the large number of patients who were either already retired or whose major activity was domestic duties.

The Pleasant Events Schedule (PES) (MacPhillamy & Lewinsohn, 1983) revealed a modest but significant increase in the frequency of leisure activities at 6 months relative to preoperative levels but there was no further improvement between 6 and 12 months; 25% reported impairment in leisure activities. One year after surgery 84% of patients reported significant improvements in their marital relationship. Involvement in family activities improved for 67% of patients but declined for 5%, and 65% of patients reported a significant increase in their social activities. However, improvements in sexual interest were modest and continued impairment in sexual activity was reported by 31% of the patients.

At 6 and 12 months after surgery 70% of patients were free of angina compared to 14% preoperatively. Although 5% of patients expressed regrets at having undergone CABG surgery 1 year earlier, 69% were either moderately or extremely pleased with the outcomes. Another 13% of patients had neutral feelings about the surgical results.

QOL was assessed in a large prospective, randomized, clinical trial of medical and surgical therapy in a subset of patients with stable CAD (CASS Principal Investigators and their Associates, 1984). At 11 participating centers, 780 patients with greater than 70% stenosis of one or more coronary arteries were assessed preoperatively, and at 6, 8, and 60 months postoperatively. Of the 390 patients assigned to the medical management group, 100 patients crossed over to the surgical group. The large majority of the variables assessed, while considered to be indicators of QOL, focused on functional status and medical complications.

The patients who physically benefited most from surgery were those with multi-vessel disease. Patients in the surgery group also reported significantly less activity limitations than those in the medical group over the 5 year follow-up period. There was also a marked reduction in the use of cardiac medications in the surgical patients and these group differences were maintained over a 5 year follow-up period and "again reflects an improved QOL in the surgically assigned patients, correlating temporally with the improved chest pain status, activity levels, and exercise test results in these patients" (CASS, 1984, p. 958).

For both groups, employment status gradually declined over the follow-up period. There were also no group differences in resumption of recreational activities or in risk factor management. Moreover, the 5 year survival was equally good in both therapy groups. This study demonstrated that, in patients who were asymptomatic after myocardial infarction or who had chronic, mild angina, elective CABG surgery, when compared with medical management, offered no advantages in terms of survival. However, the investigators concluded that surgery offered advantages in terms of improving QOL through reduction in chest pain, improvement in activity, and reduction in the need for daily drug therapy. These observations are consistent with the results of other major clinical trials of medical versus surgical therapy for stable CAD (European Coronary Surgery Study Group, 1982; Peduzzi & Hultgren, 1979).

It is interesting to note that the researchers in this study initially used variables such as rehospitalization rate and medication usage as indicators of QOL and then later implicitly assign these variables to a predictor role of the dependent variable, QOL, which is left undefined and unmeasured as a criterion. That is, the postoperative rehospitalization rate was deemed an indicator of QOL. However, later it is concluded that rehospitalization has a negative impact on QOL.

In Britain, Wallwork and Caine (1985) compared the QOL of heart transplant recipients and CABG patients before and at several intervals after surgery. They administered the Nottingham Health Profile (NHP) (McKenna, Hunt, & McEwan, 1981) to 61 transplant candidates and 84 pre-CABG patients. They obtained 3 month follow-up data for 30 transplant recipients and 64 CABG patients, and 1 year follow-up data for 22 transplant patients and 32 CABG patients.

The first part of the NHP assesses 6 dimensions of functioning: physical mobility, pain, sleep, energy, social isolation, and emotional reactions. The second part of the profile assesses areas of daily life affected by health including: occupation, ability to perform household tasks, social life, home relationships, sex life, hobbies, and holidays.

At the 3 month follow-up there were no group differences in NHP scores. By 1 year, the only significant difference in health between groups was in the energy dimension. Transplant recipients were more rested and energetic, had fewer emotional difficulties, and only slightly more sleep disturbances than the CABG patients. Both groups improved dramatically on all dimensions at 3 and 12 months postoperatively compared to their preoperative scores. The conclusion drawn was that these scores were indicative of their overall improvement in QOL.

A QOL questionnaire, developed for the study, was administered to 30 CABG patients. This 30 item instrument assessed five life areas which seem to overlap with the content of the NHP. They include: work, finances, physical symptoms, life-style, and expectations. Of 17 patients not working before surgery, 9 returned to work after surgery. Of the patients who were employed before surgery, 12 returned to work after surgery. Thus, 70% of patients were employed after surgery.

Preoperatively, 29 patients expressed both a desire and an expectation of returning to work. At 3 months postoperatively, 30% of patients described their condition as completely better and 53% described their condition as definitely improved. At 1 year, 28 patients described themselves as improved or completely better. Interestingly, only 50% of the patients said they were free of symptoms at 3 and 12 months after surgery. Eight patients were experiencing chest pain, 8 were experiencing chest tightness, and 10 were experiencing breathlessness a year after surgery. This finding is quite inconsistent with the patients' expressions of satisfaction with surgery. In the general QOL rating, which ranged from 0-10, 10 patients preoperatively and 1 at 3 months after surgery scored between 0-4. Postoperatively, 60% of the patients at 3 months and 73% at one year scored between 8 and 10.

Engblom and colleagues (1992) evaluated the effect of a comprehensive rehabilitation program on the QOL during the first postoperative year after CABG surgery in male patients randomly assigned to the rehabilitation program (n=104) or a routine hospital-based treatment (control) group (n=97). Although QOL was not defined, it was recognized as a concept influenced by many factors such as family relations and perceptions of health. Most of the subjective data was collected with unstandardized questionnaires constructed for the study.

They found that the patients' expectations of surgery were largely realistic, seeking primarily symptom relief. However, over 60% of patients expected an increase in sexual activity and almost one-half an improvement in family relationships. There was no obvious increase in the degree of satisfaction with sexual life or change in perception of family relations; yet two-thirds of the subjects regarded the surgical result to be in accordance with their expectations. Subjects satisfied with the outcome were also in a better functional class than those who were less satisfied. The authors concluded that symptom relief was crucial for the patient's satisfaction with the result of CABG surgery.

The postoperative scores on the Beck Depression Index improved from the preoperative values for the rehabilitation group but not for the control (hospital) group. A recent study of the effectiveness of behavioral therapy for treating depression and anxiety after CABG surgery also found that the control group continued to experience psychological distress 15 months after surgery whereas the treatment group improved (Brown, Munford, & Munford, 1993).

Patients in the rehabilitation group expressed more positive perceptions of their health than the hospital group one year after surgery. Perceptions of the overall life situation did not differ between the groups and there was no change from the preoperative situation to one year after surgery. The authors suggest that the reason may be that middle aged males in Finland usually have a stable life situation with most basic human needs satisfied. Further, the superior social security system maintains economic stability in spite of work disability.

Most patients offered less optimistic views of their future health and overall life situation at 6 months after surgery than they had before surgery. The rehabilitation program also induced a more active life-style than the hospital group. The patients in the rehabilitation group regarded rehabilitation measures as important whereas patients in the control group regarded support from a spouse, family, and friends, and their own mental strength as important. The overall conclusion was that while the rehabilitation program failed to show many statistically significant benefits over the hospital program, the clinical significance of the program was evident.

The Well-Being Paradigm

Penckofer & Holm (1984) conducted a study of the influence of CABG surgery on the subjective and objective aspects of QOL early in the recovery period. Two groups of CABG patients were compared; group 1 consisted of 17 patients who were 3-5 months post-CABG and group 2 consisted of 17 patients who were 6-8 months post-CABG. QOL was defined as the perceived overall satisfaction with life. Cantril's (1965) SASS was used to measure the patients' past (at the time CAD was first diagnosed), current, and future (5 year expectation) QOL. Satisfaction with family life, social life, occupation, and sexual life were measured using a 5-point likert scale (Laborde & Powers, 1980). Objective indicators of QOL included the intensity and frequency of anginal episodes, amount of physical activity, and employment.

Patients in both groups reported less angina and a higher level of activity after surgery than before surgery but there was no significant difference between groups. There was also a significant difference in QOL ratings between present, past, and future life satisfaction both within and between groups. Patients who were 3-5 months post-CABG perceived their future QOL to be better than their past.

However, patients 6-8 months post-CABG viewed both their present and future QOL as better than their past. While both groups experienced greater satisfaction in specific life domains postoperatively, the between group differences were not significant. Both groups reported more satisfaction with social life, family life, and sexual life after surgery than before. However, there were no differences between groups for occupational satisfaction or in the number of hours worked before and after surgery.

Most patients returned to work 6-8 weeks postoperatively and most felt that employers were accommodating to their needs. One patient in group 1, and two patients in group 2 who had been on disability preoperatively, returned to work. Three patients in group 1 were awaiting return to work and one patient was on disability because of age (61) and the physical nature of his occupation. In group 2, one patient was on disability because of intractable angina.

Overall, there were measurable improvements in the QOL early in the recovery period following CABG. As early as 3-5 months after surgery patients reported higher levels of life satisfaction. The difference between groups in the assessment of present life satisfaction is likely related to the differing time intervals between surgery and follow-up.

Guided by the work of Cantril (1965) and Campbell et al. (1976), Flynn and Frantz (1987) examined the impact of CABG surgery on the QOL of 29 patients during early convalescence.

QOL was defined as life satisfaction which, in turn, is the perceived discrepancy between aspirations and achievements. Using Cantril's (1965) SASS, satisfaction with specific life domains were also assessed to determine the best predictors of reported global QOL.

Patients were moderately satisfied with their present life and expected an even greater improvement in the future. The fact that patients rated past life satisfaction slightly higher than their present is understandable given that QOL was assessed only 6-10 weeks after surgery. The patients rated their present state of health slightly higher than in the past and they expected an even greater improvement in the future. Significant positive correlations were found between perceptions of present and future life satisfaction, between present and future health perceptions, between present life satisfaction and present health perceptions, and between present and future health perceptions. Despite the large number of reported complications, there was no significant relationship between any of the objective measures of health status and reported life satisfaction.

Of the 8 domains of life examined, family relationships ranked highest in importance, followed by relief of symptoms, and increased physical activity. Material wealth and ability to return to work ranked lowest in importance. The patients were most satisfied with the relief of symptoms, followed by family relationships, and social participation. They were least satisfied with leisure and sexual activity. Moreover, being married was rated as the most favorable form of support to patients.

Although the patients were more satisfied with the 2 life domains that were also ranked as most important to them, they were less satisfied with physical activity and leisure, which ranked third and fourth in importance but sixth and seventh in satisfaction. On the other hand, patients were least satisfied with the domain of sexual activity which was also ranked low in importance. The low importance placed on the ability to return to work conforms with the findings from other studies which suggest that the decision not to return to work is often the patients choice and is not necessarily related to surgical outcome (Bryant & Mayou, 1987; LaMendola & Pellegrini, 1979). Satisfaction with mood ranked fourth, suggesting a favorable psychological outcome.

Using multiple regression analysis, the three best predictors of global QOL were mood, satisfaction with wealth, and relief of symptoms. However, given the small sample size, the estimates may be quite unstable. None of the demographic or occupational variables were related to QOL. This is consistent with the findings of Campbell et al. (1976) who assert that QOL is determine by psychological factors rather than economic or demographic factors, but are in disagreement with Cantril (1965) who found positive relationships between life satisfaction and socioeconomic status. However, in this study, economic factors seemed to play a greater role in predicting QOL than Campbell et al. (1976) argued. The apparent contradiction in the findings on the economic factor may be explained by the way in which socioeconomic status was measured. In this study it was an indirect measure based on occupation and education. In contrast, subjective satisfaction with wealth was entered into the regression analysis.

When expectations for recovery were assessed, there was a significant correlation between achievement of expectations and present life satisfaction. One would expect such a relationship given that life satisfaction is define as the discrepancy between aspirations and achievements. The investigators suggested that the discrepancy between subjective reports of QOL and the objective health indicators might be explained by the fact that patients, soon after surgery, can experience a euphoric state from having survived cardiac surgery which is often perceived as a cure.

Another group of nurse researchers conducted a study of CABG patients at two western United States teaching hospitals to assess the patients' expectations and realized benefits including an improved QOL (Gortner, Gilliss, Moran, Sparacino & Kenneth, 1985). Of the 66 patients interviewed the day before CABG surgery, 34% expressed expectations of improved survival, 39% expected improved exercise tolerance, 10% expected to return to work, and 37% expected an improved QOL.

Six months after surgery, 46 of the original 66 patients were interviewed to determine if their expectations had been realized. Overall, 83% of patient expectations were realized and 85% reported an improved QOL. The typical profile of a patient expressing beneficial results from surgery included: history of a previous myocardial infarction, disease in the left main coronary artery, 80-90% narrowing of two other vessels, and preoperative expectations of lengthened lifespan and freedom from pain as a result of surgery. At the six month follow-up, such a patient had recovered and returned to former activity, and had achieved complete freedom from pain. There was a perception of an improved QOL and survival as well. When asked if they would undergo a repeat CABG, 5 patients said no.

It is important to note that in this study an improved QOL was conceived of as but one of many possible benefits after CABG surgery. However, the investigators later concluded that the sum total of all the patients' realized benefits contributed to the realization of an improved QOL, which now is viewed as a dependent variable. This lends support to the notion that QOL is appropriately interpreted as a global, unidimensional evaluation of one's life.

Recently, this group of researchers have compared the ratio of realized to expected benefits from cardiac surgery of subjects over 75 years of age (Gortner, Jaeger, Harr & Miller, 1994). The total sample of 199 subjects included 123 patients undergoing first time and repeat CABG surgery. Patients were asked to rate their preoperative expectations of health recovery, QOL, and life satisfaction on a scale of 0 (lowest) to 10 (highest).

Patients' expectations of benefits were elicited the day before surgery regarding perceived prolongation of life, improved QOL, resumption of former activities, and ability to travel and engage in recreational activities. At the 6 month assessment, 97 CABG patients were telephoned for recovery reports and asked which benefits expected before surgery had been realized.

All patients reported high benefit ratios (proportion of realized to expected benefits) at 6 months with perceived prolongation of life, improved QOL, and return to former activities being realized with greatest frequency. Only three of the CABG patients reported nonrealization of perceived prolongation of life at 6-month follow-up. Angina at baseline and a high NYHA functional class at 6 months were the only significant predictors of an improved QOL, underscoring (according to the authors) the impact of angina relief on QOL. However, except for baseline recovery expectations, only objective clinical variables were entered into the multiple logistic regression model. The literature clearly indicates that the relationship between objective clinical variables and perceived QOL is weak.

Presence of diabetes at baseline, incidence of postoperative complications, poor baseline mobility status, and a higher NYHA functional class at 6 months were significant predictors of inability to return to former activities at 6 months. Baseline severity of illness as well as patients' own treatment expectations were negative predictors of ability to engage in travel and recreational activities. At baseline 86% of the CABG patients reported angina, but at 6 months 74% of the total sample had realized the benefit of being free from pain and fatigue. The researchers concluded that in their sample the severity of illness on admission influenced the ratios of realized to expected benefits for improved life quality and return to former activities. Patients who had angina at baseline were more likely to rate their QOL as improved 6 months after surgery; those without anginal pain at baseline may not have been significantly functionally impaired, and therefore, may not have realized the treatment effect to the same extent as those with symptoms.

At the University of Rochester, nurse researchers assessed the QOL of individuals undergoing CABG using a multidimensional approach in an effort to better understand individual perceptions of QOL (King, Porter, Norsen, & Reis, 1992). Life satisfaction, mood state, angina level, and work status were assessed in 225 patients the day prior to surgery. One year after surgery, during a telephone interview and through a mailed questionnaire, all presurgery measures were again assessed in 155 patients. The measure of functional disruption was assessed and returned by mail prior to the telephone interview.

The researchers found that the mean scores for satisfaction with life were positively skewed and did not change over time. Positive mood scores significantly increased and negative mood scores significantly decreased from before to one year after surgery. The percentage of patients experiencing angina decreased from 81% to 21%. By one year after surgery, disruption in ability to maintain usual life activities was low. Of 65 patients employed at surgery, 56 had returned to work by one year after surgery.

Four mutually exclusive categories of responses were derived from subjects' responses to the open-ended question about the value of surgery. The categories were (a) worth it because it improved functioning (43%), (b) worth it considering the alternative of death or myocardial infarction (42%), (c) not sure (10%), and (d) not worth it (5%). Most subjects who were not sure surgery was worth it perceived no change in their health or functional status, although this was primarily because they did not feel impaired prior to surgery.

The majority of subjects believed that having surgery was worth it but, interestingly, their descriptions of why were evenly divided between perceptions of functional improvement and perceptions of being saved from more serious illness or death. Those who cited functional improvement had the most positive scores on life satisfaction and mood states while those who perceived being saved from more serious illness or death did not differ on these measures from subjects perceiving no benefit from surgery. Yet, both groups who believed surgery was worth it were similar in that they realized a significant decrease in angina and for the most part, had returned to work. These results are consistent with other reports of lower than expected subjective QOL in a subset of patients with improvement in angina (Flynn & Frantz, 1987; Mayou & Bryant, 1987).

Although it is not unexpected that subjects who perceived no benefit from surgery rated QOL lower than did those who did perceive benefit, it is interesting that scores on life satisfaction and mood states differed between the two groups believing surgery was worth it. The researchers suggest that it may be that perceptions of health are influenced by whether one focuses on functional ability or on affective state.

Recurrence of angina or physical complications could account for the few subjects who did not believe that surgery was worth it. All of the subjects in this group were symptomatic preoperatively but perceived themselves to be in worse health status after surgery. Subjects who were not sure that surgery was worth it also did not perceive a change in health status.

All of the selected subjective indicators of QOL (life satisfaction, positive mood, negative mood, and angina severity) were significantly intercorrelated. For the sample as a whole, functional disruption was moderately to highly related to measures of emotional well-being. The authors suggest that these findings indicate that while QOL is multidimensional, there is considerable overlap between perceptions of physical and emotional health. However, the subjective and objective indicators of QOL were not consistently related. While clinical indicators such as angina are important to enhance understanding of the recovery process, they do not appear to be consistently related to perceptions of outcome.

A randomized clinical trial was recently conducted to determine the efficacy of a psychoeducational nursing intervention in patients recovering from CABG and valve repair surgery (Gilliss, Gortner, Hauck, Shinn, Sparacino, & Tompkins, 1993). An important goal of the study was to identify the factors contributing to patient QOL and reported activity 6 months after surgery. The following outcome measures were obtained preoperatively and 4, 8, 12, and 24 weeks postoperatively: mood, self-efficacy, activity, and QOL.

QOL, measured on a 0-10 scale, improved with time in both the experimental (n=75) and the control group (n=81). Four weeks after surgery, the control group average was substantially (10%) below that of the experimental group. By 12 weeks, the control group had caught up with the experimental group. QOL was not significantly different between the groups. The over-time improvement for all subjects, according to the authors, suggests that QOL is a state rather than a trait variable and a sensitive marker of change.

The first regression model predicting patient QOL at 24 weeks explained 24% of the variance. The most significant predictor was baseline QOL, explaining 10% of the variance; NYHA class at 4 weeks after surgery was significant in predicting 3%. The effect of the intervention on levels of self-efficacy was limited. Patient mood does not appear to be affected by the experimental intervention; mood state improved significantly over time for all patients.

The authors concluded that the two significant predictors of QOL - baseline scores and NYHA functional class at 4 weeks - suggest that although QOL is fairly stable for most subjects, it is influenced by functional outcomes. However, they did not find self-efficacy (not defined) contributing to QOL.

QOL, mood state, and physical functioning was evaluated in 44 patients undergoing CABG and 32 patients undergoing PTCA (Papadantonaki, Stotts, & Paul, 1994). Both groups were compared the day before revascularization and 3 weeks after hospital discharge. QOL was measured with the Quality of Life

Index, Cardiac Version III (QLI-Cardiac III), which is a 36 item scale that rates satisfaction and importance (Ferrans & Powers, 1985).

The QLI-Cardiac III consists of four subscales: health and functioning, socioeconomic, psychologic/spiritual, and family. The instrument is scored by weighting satisfaction responses with importance responses; scores range from 0-30. For this study, two items were added to each section regarding satisfaction with and importance of the amount of chest pain and the changes in lifestyle because of heart problems.

The findings indicate that patients who have undergone elective CABG and PTCA have a similar QOL, mood state, and physical functioning before revascularization. Moreover, there was not a statistically significant change in QOL over time or between groups. There was, however, significant improvement in the health and functioning subscale in both groups when compared with their baseline measures. The lack of improvement in QOL reported by patients could reflect the early phase in the recovery period after revascularization.

There was a statistically significant improvement in global mood state for patients in both groups after revascularization. The improvement was thought to be due to the significant decrease in tension, anger, confusion, and depression in both groups. In addition, the mood of patients in the PTCA group improved more than that of the CABG group.

Subscale scores showed that patients in the CABG group had a decrease in vigor and a slight decrease in fatigue, whereas the patients in the PTCA group reported an increase in vigor and a substantial decrease in fatigue. However, CABG surgery requires a longer convalescence and patients are advised to limit activity during the postoperative period.

The authors reported that there was a significant improvement in physical functioning for both CABG and PTCA groups when scores before revascularization were compared with scores during early convalescence after CABG and PTCA. The PTCA group reported significantly better physical functioning than did the CABG group.

Scheier et al. (1989) conducted a study of 51 men in Pittsburgh to determine the effect of dispositional optimism on the recovery from CABG surgery and on QOL 6 months after surgery. Optimism was measured preoperatively, and 1 week and 6 months postoperatively by the Life Orientation Test (LOT) (Scheier & Carver, 1985) which provides a self-report measure of global optimism. At the 6 month assessment, QOL was measured using 31 items of the Perceived Quality of Life Scale (Andrews & Withey, 1976). Measures of anxiety, depression and hostility were also obtained before and after CABG surgery using the Multiple Affect Adjective Check List (MAACL) (Zuckerman, Lubin, & Robins, 1965).

The patients' level of optimism did not correlate with any indicators of preoperative health status or with any surgical data. Dispositional optimism appeared to have a broad effect on the patients' responses to and recovery from CABG surgery. In the first week after surgery, they tended to recover physically more quickly than did pessimists. They were also more likely to have returned to various life activities by the six month assessment.

Optimists reported being less hostile and depressed after surgery than pessimists. They also reported greater satisfaction with medical care and with the amount of social support they were receiving from friends and family. Further, optimists were more likely to make plans for themselves and set goals for their recovery. They were more likely to request information about what was expected of them in the recovery period.

Of the 6 preoperative patient expectations measured, during the first postoperative week, only expected happiness was strongly related to reported happiness. After surgery, preoperative patient expectations about returning to sexual activity, about return to work, and about the resumption of social activities were significant predictors of both if and how soon these activities would resume. The findings suggest that both domain-specific expectancies and dispositional optimism can predict important outcomes related to recovery from CABG surgery.

There was a strong positive relationship between preoperative dispositional optimism and subjective QOL at 6 months after surgery. This finding is particularly important given that the majority of these patients had 2 vessel disease of 50% narrowing; a patient population for which CABG surgery is thought to have no advantage in terms of improved survival. That is, research suggests that for this group of patients, the benefit of CABG (relative to medical treatment for angina) is limited to an enhanced QOL rather than to a prolonged life.

A group of researchers explored the relative importance of dispositional optimism and control appraisals for QOL after CABG surgery (Fitzgerald, Tennen, Affleck, and Pransky, 1993). One month before CABG surgery, 49 patients completed measures of QOL, internal health locus of control, situation-specific and generalized control appraisals, and dispositional optimism. Objective indicators of illness severity were also obtained. Eight months after surgery, participants once again provided reports of their QOL.

QOL was operationalized with three surgery outcomes: angina pain, negative affect, and life satisfaction. Even though these measures were deemed indicators of QOL the author reasoned that "if an individual experiences relatively less chest pain, was less emotionally distressed, and was more satisfied with life after surgery, QOL for that individual would improve." (p. 31). Therefore, while they selected measures as indicators of QOL, they later implicitly suggest that these measures are in fact predictors of the dependent variable QOL which is left undefined and unmeasured. Further, since these three measures were only moderately associated, they were examined separately.

Overall life satisfaction as well as satisfaction with activity level, and satisfaction with sexual functioning were assessed. These measures were combined into a composite score because they were moderately correlated. Justification for the selection of the specific domain satisfactions is not offered.

The results showed that the patients' specific expectations regarding the outcome of CABG were quite optimistic. An analysis of control appraisals revealed that, although the patients showed a strong internal orientation, they did not believe that they had a great deal of control over the course of their illness. With regard to QOL, most of these patients entered the study experiencing pain upon mild to moderate exertion yet did not report a great deal of negative affect, nor were they grossly dissatisfied with their lives.

Considering first presurgery associations, the researchers found that optimism showed a strong association with negative affect but that it was unrelated to pain or satisfaction. Surprisingly, optimism was unrelated to specific expectancies. Although optimism showed a weaker relation with internal locus of control it showed a significant association with the specific control appraisal regarding illness course. Internal health locus of control was associated with specific control appraisals.

Each of the three indicators (chest pain, negative affect, life satisfaction) suggested that QOL was enhanced for these patients following CABG. They reported less chest pain after surgery than prior to surgery. One could argue that this is a health outcome and not a QOL outcome. Participants were also more satisfied with their functioning after surgery than they had been before and reported less negative affect after surgery than before. Interestingly, negative affect prior to surgery showed a moderate correlation with negative affect 8 months after surgery, angina showed a modest temporal relation, and satisfaction ratings were independent over the 8-month period. This suggests that QOL, as measured by life satisfaction, is a stable concept whereas negative affect is a transient affective state, and chest pain is an indicator of physical health status. That these three variables, as a group, are considered indicators of QOL is confusing.

In exploring the predictors of angina, negative affect, and life satisfaction in three regression models, the researchers reported that pain prior to surgery made a significant contribution to the prediction of the 8-month pain. The optimism measured prior to surgery made a unique contribution to the prediction of 8-month pain accounting for an additional 10% of the variance.

Negative affect 8 months earlier accounted for 32% of the variance in 8-month negative affect. Neither medical severity nor optimism accounted for significant variation once pre-surgery negative affect was entered into the equation. In the regression equation examining satisfaction 8 months after surgery, neither satisfaction prior to surgery nor the medical severity index made a significant contribution to the prediction. But again, optimism measured prior to surgery made a unique contribution to the prediction of 8-month satisfaction, accounting for the entire 10% variation in satisfaction explained in the equation. Thus, the Life Orientation Test scores (dispositional optimism) predicted significant variation in two of three QOL criterion variables, even after controlling for pre-surgery levels of each variable and medical severity.

Despite their rather significant physical impairment and pain, CABG patients as a group were only somewhat dissatified with their lives prior to surgery and were not experiencing a great deal of negative affect. Perhaps this speaks to people's resiliency under threat or their ability to adjust their expectation. Unfortunately the researchers conclude that "although life quality may be well captured in this population through reports of angina, negative affect, and life satisfaction, we would be more confident with 'harder' outcomes such as objective indicators of work capacity and verified social activities" (p. 40). It is well documented in the literature that return to work can no longer be equated with improved QOL. Moreover, there is little relationship between objective and subjective indicators of QOL. It seems that the researchers would prefer "harder" data in terms of health outcomes - a concept uniquely different from QOL.

Summary

Viewed from a historical perspective, the diversity in conceptualizations of QOL can be understood best by considering the times and contexts in which the researchers worked. With economic prosperity and technical advances came a need to determine how various populations viewed their environments. A great deal of research was conducted in search of social indicators of QOL to provide a framework for viewing society and for providing information to policymakers. Given that the first major thrust of activity in assessing societal well-being was that devoted to quantifying economic aspects, perhaps one ought not to expect that this extensive body of research would easily generalize to the assessment of QOL in the health care field. However, the scientists of the SIM significantly contributed to current understanding of SWB as they sought ways of conceptualizing and measuring subjective perceptions of QOL.

Advancements in medical technology, the ascendancy of chronic disease as the primary target of intervention, and limited resources have brought the concept of QOL to the interest of health care researchers in the last decade.

Rather than converging with the SIM, the medical community have paradigmatically shifted away from the subjective and global nature of QOL to a narrower conceptualization in terms of health and physical dysfunction. In fairness, QOL is a relatively new and still evolving outcome concept in health care research. To a certain extent it is probably popular ahead of its time, making it vulnerable to both abuse and discredit, particularly through oversimplification.

Several conceptualizations of QOL have been presented to demonstrate that not only are they often ideologically distinct but also that basic underlying assumptions are often obscure and not immediately evident. Particularly in the health care setting, there has been little success in identifying common conceptual themes of what constitutes QOL. An implicit assumption in much health care research is that health is a valid indicator of QOL. However, there is little evidence that healthy individuals perceive their QOL more positively than those with stable chronic conditions. Gill (1984c) believes that easily accessible indices such as morbidity and mortality are at least incomplete and at worst arrogant, in evaluating the quality of a patient's life. Most researchers state conclusions about QOL that have nothing to do with the evidence presented; they merely force a connection.

There is substantial evidence that satisfaction and happiness are, to a significant extent, the result of perceived gaps between what one has and a number of standards against which one's situation is judged. The MDT offers information as to which standards are subjectively most important in evaluating these discrepancies. The concept of multiple discrepancies is a promising candidate for the theoretical explanations of the determination of subjective QOL. Employing the MDT in a new context, namely, the health care community, may provide the vehicle for pulling together the diverse, fragmentary, and inconsistent conceptualizations of QOL. The MDT has the potential for providing the bridge for collaboration between social scientists and health care researchers in convergent QOL research.

In reviewing the literature on QOL and CABG surgery, it is evident that the particular paradigm subscribed to strongly influenced the research methodology and the conceptualization of QOL. The psychiatric diagnoses described by the researchers aggregated within the psychiatric paradigm may be inappropriate measures for making inferences about QOL. Many psychosocial responses are understandable in terms of physical impairment, social circumstances, and other environmental stressors affecting these patients. Mayou (1989) argues that psychiatric terminology is often inadequate for assessing various psychosocial influences on illness as well as psychosocial consequences of being ill.

Many of the researchers in the medical paradigm equated objective disease status with QOL. As such, it exemplifies a threat to construct validity called construct underrepresentation (Cook & Campbell, 1979; Messick, 1989). Health or the absence of disease is too narrow a definition of QOL and fails to reflect the subjective, global nature of QOL. Messick (1988) would probably agree with the assertion that these researchers have an ethical obligation to justify the relevance and utility of using the numerous instruments purported to measure QOL after CABG surgery.

Interestingly, within the medical paradigm, many researchers found that objective indicators of health bore little relationship to the subjective perceptions of health. While most researchers concluded that CABG surgery resulted in an improved QOL for most patients, QOL was measured with such a diversity of instruments that this conclusion must remain tentative. The inferences drawn from the scores, not the instruments themselves, possess questionable validity.

Most of the studies on QOL and CABG surgery lacked guidance from theory resulting in the risk that "the increment of meaning may ultimately approach zero" (Peak, 1953, p.288). Since there are no accepted gold standards for measuring QOL, evidence of construct-related validity is extremely difficult to attain. More fundamentally, the lack of theoretical work in the area of QOL makes any attempts at measuring the construct of questionable utility. Before the QOL concept is used as the outcome criterion of medical interventions there is a need for an adequate conceptual grasp of what the QOL domain encompasses. Without the benefit of an underlying theory, measures of QOL can only provide, at best, descriptive insights; they cannot yield explanatory power.

III. METHODS AND PROCEDURES

The purpose of this study is to provide evidence of construct-related validity of QOL by statistically analyzing 4 models of QOL of CABG surgical patients. A pre-experimental survey design was used for this study. This chapter provides a description of the study sample and setting, the data collection instruments, and the data collection procedures. The hypotheses and operational definitions are followed by a discussion of the data analysis strategies.

Sample

The population from which this convenience sample was drawn included all patients who underwent CABG surgery in one western Canadian centre. The sampling frame included the first 306 patients undergoing CABG surgery for the first time. Additional criteria for admission into the study included:

1. undergoing CABG surgery without additional cardiac surgical procedures,
2. oriented to time, place, and person with no history of acute or chronic psychiatric illnesses,
3. able to read, write, and speak in the English language and capable of responding in an interview situation.

Setting

The study was conducted in a large urban teaching hospital in western Canada. This hospital is a 1355 bed acute care teaching facility, and the major specialty care referral centre for the province and the Territories. Patients scheduled for CABG surgery are routinely admitted to a 25-bed cardiovascular surgical nursing unit the day prior to surgery. Following surgery, the patient is admitted to a 10 bed cardiovascular intensive care unit (ICU). After approximately 24-36 hours the patient is transferred back to the surgical nursing unit until hospital discharge approximately 6 days after hospital admission.

Instrumentation

Data for this study was obtained from multiple sources through several data collection instruments. The data sources included the patient, the patient's medical record, and the patient's cardiothoracic surgeon familiar with the patient's functional status. The next 4 sections describe the data collection instruments under the following major headings: Global Perceived QOL, Satisfaction With Life Domains, The Multiple Discrepancies Theory, and Perceived Health.

Global Perceived Quality Of Life

Five instruments were chosen as measures of global perceived QOL based on the conceptual framework of Campbell et al. (1976) and Andrews and Withey (1976). They include the Index of Well-being (IWB) (Campbell et al., 1976), the Life 3 Scale (Andrews & Withey, 1976), the Faces Scale (Andrews & Withey, 1976), the Self-Anchoring Striving Scale (SASS) (Cantril, 1965), and the Life-as-a-Whole item (hereafter referred to as MDT1) from the Multiple Discrepancies Theory (MDT) (Michalos, 1991a).

Index of Well-Being

The IWB is a two-part measure of reported subjective well-being (SWB) (see Appendix D). The IWB is the sum of (1) the mean score on an Index of General Affect (IGA) (a set of eight items on semantic differential scales) and (2) a single-item assessment of life satisfaction on a 7-point Likert scale. The satisfaction item (hereafter referred to as Life Satisfaction) is weighted 1.1 and then added to the mean IGA response to compute the final score. IWB scores can range from a low of 0 to a high of 14.7.

The scale was administered to a probability sample of 2,160 American adults aged 18 and older in the summer of 1971; eight months later 285 of the respondents were interviewed again (Campbell et al., 1976). Mean scores on the IWB were 11.8 for the entire sample (SD=2.2), with 31% of the sample scoring 13 or higher on the index. Persons over 65 years of age scored above the mean score on the index, as did wealthy individuals, married people without children, and residents of rural areas. Among unemployed, low-income, divorced, separated, and single young adults, scores were particularly low. Women scored slightly higher than men on the index and whites higher than blacks after controlling for income.

Campbell et al. (1976) found substantial intercorrelations among most of the items on the semantic differential scales. Two scales did not correlate as highly with the other eight. These scales used the adjective pairs *easy* versus *hard* and *free* versus *tied down*. Intercorrelations among the other eight items ranged from 0.40 to 0.61. However, the correlation of the two discrepant items with the other eight items was about 0.27. Therefore, Campbell et al. (1976) deleted these two items from the scale and the remaining eight items were combined to form the IGA.

The mean value for the Life Satisfaction question, when administered to a random sample of 2,134 American adults, was 5.5 with a standard deviation of 1.25 (Campbell et al., 1976). The distribution of scores revealed heavy clustering at the positive end of the scale. Cronbach's alpha for the eight items in the IGA was 0.89. The IGA correlated 0.55 with the Life Satisfaction question. Test-retest correlations for 285 respondents about eight months later were 0.43 for the IWB and 0.56 for the IGA. The IWB correlated 0.20-0.26 with measures of fears and worries and the IGA correlated 0.52 with a measure of happiness.

In order to estimate test-retest reliability, Molzahn (1989) administered the IWB to 20 end stage renal disease (ESRD) patients and their health care providers and again approximately six weeks after the first administration. The reliabilities for the IWB for the patients, nurses, and physicians were 0.42, 0.86, and 0.85, respectively. The test-retest reliabilities for the IGA were 0.53 for the patients, 0.94 for the nurses, and 0.85 for the physicians.

Like Campbell et al. (1976), Molzahn (1989) identified the same two semantic differential items which did not correlate well with the other eight items of the IGA. After Molzahn excluded these two items, the remaining intercorrelations were about 0.50. The alpha coefficient for the IWB was 0.91 for the patients' reports, 0.96 for the nurses, and 0.95 for the doctors. Molzhan (1989) also found that the scores on the IWB correlated positively with the SASS (r=0.65).

Life 3 Scale

Of the 68 measures of global QOL that Andrews and Withey (1976) administered to a probability sample of nearly 4,000 Americans, the Life 3 Scale was judged to be the most reliable and valid indicator of respondents' true feelings about life-as-a-whole (see Appendix E). The impetus for the development of this scale was the observation that when Campbell et al. (1976) used the 7-point Satisfaction Scale to assess people's feelings about QOL, heavy clustering occurred at the positive end of the scale. For the 10 life domains most central to their study the response distributions showed two-thirds of adult Americans selected the two most satisfying categories. Andrews and Withey (1976) developed the Delighted-Terrible (D-T) Scale to provide more precise discrimination among the large group of people who were very satisfied with their lives.

The Life 3 Scale is a derived measure based on two questions that ask respondents to evaluate their life as a whole on a 1-7 D-T scale. The response scale categories were developed as a tool that would yield more valid and discriminating information about people's evaluation of different aspects of life by providing labels for each scale point and by including more affect than previous satisfaction scales. The Life 3 Scale is the mean value of the same item asked twice (represented as Life 1 and Life 2) of each respondent, separated by 15-20 minutes of other questions about QOL using this and other scales. Scale scores run from a low of 2 to a high of 14. Andrews and Withey (1976) found that few respondents objected to answering this question twice and many failed to notice it.

Andrews and Withey (1976) administered the Life 3 Scale in four national surveys conducted in May (N=1,297) and November (N=1,072) of 1972, and in April (N=1,433) and July (N=222) of 1973. In the April survey a mean score of 10.8 was reported. The correlations of Life 1 and Life 2 for the May, November, and July respondents were 0.61, 0.71, and 0.64, respectively. The two items correlated 0.68 in the April national sample (separated by 20 minutes), from which a Cronbach's alpha of 0.81 was derived. Further, the Life 3 Scale correlated 0.54 with a modified version of Cantril's (1965) ladder and 0.57 with interviewers' rating of the respondents' life satisfaction.

Andrews and Withey (1976) reported that 93% of the respondents of the April survey chose a category in answering Life 2 that was either identical or immediately adjacent to the category they chose when answering Life 1 (52% chose identical categories). Overall, Andrews and Withey (1976) regard the Life 3 Scale as "one of our best measures of global well-being" (p. 107). They suggest that this measure shows meaningful relationships to a variety of specific life qualities. Moreover, it relates substantially to feelings of life being happy, satisfying, interesting, rewarding, ideal, and enjoyable. It was also discovered that 50-62% of the variance in Life 3 could be predicted from as few as four or five specific domains of life such as satisfactions with self and family.

The highest relationships of specific life concern measures to general well-being are those involving concerns that are close and immediate to people's personal lives and over which they may have direct influence. Andrews and Withey (1976) suggest that important characteristics of one's own life predictive of Life 3 include how much fun, enjoyment, and interest it has; aspects of personal self-efficacy, adjustment, accomplishment; one's marriage; how one is treated and accepted by other people; and economic concerns such as one's income, and the extent to which one's physical needs are met.

Using structural equation modeling, a validity estimate of 0.77 (65% valid variance, 8% methods variance, 27% residual variance) was obtained, higher than the nine-point ladder rating (0.73), and the interviewers' rating (0.66). The validity estimate of 0.77 for the Life 3 Scale is based on two items, Life 1 and Life 2 and this estimate is somewhat higher than that of either of its components. Andrews and Withey (1976) estimated that the validity of the components was about 0.71. Analysis of the ladder scale revealed 50% valid variance, 5% methods variance, and 45% residual variance.

Faces Scale

The Faces Scale, developed by Andrews and Withey (1976), is a means of eliciting assessments of QOL without using verbal labels for the scale categories (see Appendix F). Seven faces with expressions ranging from very positive to very negative are shown to the respondent. The facial expressions are clear and each face is represented by a letter ranging from A (smiling face) to G (frowning face). Labeling each face with a letter was considered an improvement over scales with only the end categories labeled, leaving the meanings for the intermediate categories potentially ambiguous.

Respondents are shown seven faces ranging from wide smiles to turned-down mouths. They are told: "Here are some faces expressing various feelings (delighted, pleased, mostly satisfied, mixed, mostly dissatisfied, unhappy, and terrible). Below each is a letter. Which face comes closest to expressing how you feel about life as a whole?"

In the April survey, Andrews and Withey (1976) found that when compared to the Life 3 measure, the distribution for the Faces Scale was more clustered at the positive end of the scale. However, the validity coefficient was identical to the Life 3 measure (0.77). In the July survey (N=222), Andrews and Withey (1976) found that the seven categories of the Life 3 measure and the respective categories of the Faces Scale seemed to have been assigned highly similar meanings by these respondents because there was very close correspondence between the seven categories on both scales. However, Lance and Sloan (1993) found that the Faces Scale and the Life 3 Scale represent different measurement methods.

Self-Anchoring Striving Scale

Cantril's (1965) SASS is designed to measure overall SWB. This scale, depicted as a 10-step ladder, has been administered to 20,000 people in 13 countries including the United States and Canada. The instructions for the instrument have been back-translated from English to 26 different languages. In 1959, the SASS was administered to a sample of Americans (n=2,696) ranging in age from 21 to over 65 years.

Cantril (1965) conceptualizes SWB as a cognitive experience in which the individual compares perceptions of the current life situation to a situation aspired to, expected, or felt deserved. The discrepancy between one's perceived life and one's aspirations is expressed in a measure of the degree of satisfaction with greater satisfaction taken as an indicator of SWB. Cantril (1965) addressed the issue of validity of the instrument in terms of content validity. He reported that prior to instrument construction for his international study and after an extensive literature review, 3000 subjects worldwide were interviewed to obtain the aspects of life thought to be most satisfying. Cantril (1965) believed that the respondents' contributions were "plausible, honest, and sincere" (p.25).

When administering the the SASS, each subject is asked to identify the best possible life imaginable. Next, the subject is asked to define the worst possible life imaginable. A picture is then shown of Cantril's SASS as a 10-step ladder (see Appendix G). The best possible life is represented by the top of the ladder (rung 10), and the worst possible life is coincident with the bottom (rung 0) of the ladder. These scale end points represent the subject's own perception of maximum and minimum life satisfaction. Using the scale endpoints as personally defined reference points, subjects are asked to indicate where on the ladder they would place themselves 5 years ago, presently, and 5 years hence. These designations constitute the scores for each time period.

The ratings people assign themselves are entirely subjective, assessed against their own standards and aspirations. That is, "all ratings are anchored within an individual's own reality" (p.25). Therefore, a rating given by one person may not mean the same thing as a rating given by another person. However, since the extremes are entirely personal, the meaning of the end points may remain relatively constant for a given individual over a short period of time, thereby, minimizing the error variance.

When used in a Canadian survey, the SASS was assessed as one of the best of a number of SWB measures used (Atkinson, 1982; Horley & Lavery, 1991). When evaluating a number of SWB measures, Larsen, Diener, and Emmons (1985) found that in four samples of college students, the test-retest reliability (1-2 months) ranged from 0.32 to 0.41. Cantril's SASS correlated positively (r=0.49) with Rosenberg's Self-Esteem Scale (Rosenberg, 1965). Using structural equation modeling, Andrews and Withey (1976) found that the validity estimate of the ladder scale was 0.59 in the July survey and 0.73 in the April survey. Moreover, Andrews and Withey found that the ladder scale produced the least skewed distribution of all the global measures of SWB assessed in the April survey. That is, the instrument produced "well-spread and reasonably symmetric distributions" (p. 209).

More recently, the SASS has been used in a number of patient populations including ESRD patients (Laborde &

Powers, 1980; Stegman, Duncan, Pohren, & Sandstrom, 1985; Molzhan, 1989) and CABG surgical patients (Penckofer & Holm, 1984; Flynn & Frantz, 1987) and their wives (Artinian, 1991; Artinian & Hayes, 1992). The mean of the present, past, and future QOL ratings on the SASS were 6.74, 3.5, and 8.32, respectively, for CABG patients 3-8 months after surgery (Penckofer & Holm, 1984). Patients who were 6-8 weeks post-CABG reported mean present, past, and future SASS scores of 6.41, 6.51, and 7.75 (Flynn & Frantz, 1987). The wives of 86 CABG surgical patients reported a mean SASS score of 8.62 reflecting their perceptions of their husband's severity of illness during the surgical hospitalization. The mean SASS score fell to 6.83 when the wives' perception of their husband's severity of illness was assessed 6 weeks after hospital discharge (Artinian, 1991).

Life-as-a-Whole (MDT1)

The first item of the MDT questionnaire (to be discussed shortly) asks the respondents to assess their life-as-a-whole. Since this is a global measure of perceived QOL without an explicit standard of comparison, it was included as an indicator of perceived QOL. The item reads, "How do you feel about your life as a whole right now?" (Michalos, 1991a). The response scale is a modification of the original D-T Scale constructed by Andrews and Withey (1976). The response categories for the MDT1 item are: terrible (1), very dissatisfying (2), dissatisfying (3), mixed (4), satisfying

(5), very satisfying (6), and delightful (7). The difference between the Life 3 indicator of QOL and the MDT1 indicator of QOL is that the latter scale has replaced the Life 3 descriptor unhappy with very dissatisfying and pleased with very satisfying. That is, the affective tone of the D-T Scale has been replaced with a scale that emphasizes assessment or evaluation.

Satisfaction With Life Domains

This section describes the questionnaire which was administered to determine the satisfaction of CABG surgical patients with four specific life domains. Four life domains were chosen to determine their causal influence on perceived QOL. Andrews and Withey (1976) found that areas of life in which people were immediately and personally involved, and over which they might have substantial personal influence were more predictive of global QOL than areas of life which were more remote from one's immediate personal life. Therefore, the four domain satisfactions thought to have direct effects on perceived QOL are: satisfaction with self, satisfaction with health, satisfaction with family, and satisfaction with friends (see Appendix H). Each domain satisfaction is measured using two items - one is taken from the work of Campbell et al. (1976) and the other from the work of Andrews and Withey (1976).

The first set of four questions is taken from Campbell et al. (1976). These items use a bipolar scale with completely dissatisfied at the left of 7 equally spaced lines and completely satisfied at the extreme right. The middle spaces are without labels. For simplicity in future discussions, this scale will be called the Satisfaction Scale. The second set of four items use a 7-point scale with descriptors ranging from terrible to delightful. This scale will be referred to as the D-T Scale. The four life domains were measured with this second set of items because Campbell et al. found that their Satisfaction Scale produced markedly skewed distributions for many of the domains they studied.

Andrews and Withey, believed that an improvement of the Satisfaction Scale would consist of enhancing its affect tone, and in turn, reducing the skew of the distributions generated. The D-T Scale descriptors include: delighted, pleased, mostly satisfied, mixed-about equally satisfied and dissatisfied, mostly dissatisfied, unhappy, and terrible. In addition, the scale includes three off-scale categories: neutral-neither satisfied nor dissatisfied, does not apply to me, and I never thought about it. These off-scale categories were not used in the present study because, of the four domains of life selected for study, all were thought to be sufficiently relevant to the CABG surgical patients that a response could be generated.

An advantage of the D-T Scale items is that all categories of the scale are explicitly labeled whereas only the end categories of the Satisfaction Scale are labeled.

Andrews and Withey (1976) believed this left some ambiguity as to what the respondent was expressing when choosing one of the intermediate, unlabeled categories. Further, Andrews and Withey (1976) included the 7-point Satisfaction Scale in their November 1972 survey (N=1,072) and found that the Satisfaction Scale had estimated validities which were lower than those of single items utilizing the D-T Scale. The D-T Scale produced measures that contained about 8% more valid variance than those produced by the 7-point Satisfaction Scale.

Of the four domains of life central to this study, Campbell et al. (1976) found that the highest mean score was for the satisfaction with family life (5.92), followed by the satisfaction with health (5.78), and the satisfaction with friendships (5.74). Satisfaction with self was not explicitly studied by Campbell et al. (1976); they admit this was an oversight. The question regarding satisfaction with self which was adapted for this study read, "Up to now, have you been able to satisfy most of your ambitions in life or have you had to settle for less than you had hoped for?" (Campbell et al., 1976, p. 556). Since this question could not be answered with the Satisfaction Scale, the wording of the question was modified for this study permitting a response on the Satisfaction Scale. For all these domain satisfaction measures Campbell et al. (1976) found that responses tended to cluster heavily toward the more satisfied end of these scales. The test-retest reliability estimates of these measures, after an eight month interval, ranged from 0.42 for friendships to 0.67 for health.

Andrews and Withey found that, of all the domains of life examined, respondents expressed the strongest pleasure with family life. The mean values for the May 1972 and November 1992 surveys were 5.8 and 5.4, respectively, with an average of 41% of respondents expressly pleased with the time spent with their families. The mean value for the domain of health was 5.3 in the May survey and 5.1 in the November survey. In the May survey, 28% of respondents were mostly satisfied with their health while 53% were either pleased or delighted. In the November survey, 34% were mostly satisfied with their health while 45% were either pleased or delighted.

The mean value for the domain of friends was 5.6 in the November survey with 57% of respondents being either pleased or delighted with their friends. The last domain explored, relevant for present purposes, was regarding a self-evaluation of one's accomplishments. Andrews and Withey (1976) believed that how one viewed themselves, and their chances, opportunities, and progress affected QOL. The mean values for the May and November surveys were 5.1 and 5.0, respectively. Overall, about 38% of respondents were mostly satisfied with their accomplishments and about 35% were pleased or delighted.

Andrews and Withey (1976) found that 12 of the 30 areas of life used to predict global perceived QOL were able to account for 50% of the variance in the concept in the May survey and 62% of the variance in the November survey. Of those 12 predictors, assessments of self accomplishments demonstrated the greatest predictive power, followed by the satisfaction with family. The satisfaction with health was less predictive of QOL in the national sample probably because the respondents were relatively free of acute or chronic physical or mental illnesses; good health is often taken for granted. Interestingly, the satisfaction with friendships was not among the 12 most predictive life areas explored. The researchers concluded that as few as four or five life areas could as effectively predict QOL as the 12 domains they found most predictive.

The Multiple Discrepancies Theory

This section describes the questionnaire administered to determine the effects of the MDT on perceived QOL. According to the MDT, overall perceived QOL is a function of seven perceived discrepancies between one's current life and a set of internal standards (Michalos, 1991a). These discrepancies are between what one has and wants, relevant others have, the best one has had in the past, expected to have 3 years ago, expects to have after 5 years, deserves, and needs. A seven item questionnaire, a short version of the original instrument designed by Michalos (1985, 1991a), was used to assess the various discrepancies in an attempt to add clarity to how the CABG surgical patients formulate their global QOL (see Appendix I).

The original questionnaire explored 12 domains of life in addition to global satisfaction from eight different perspectives (seven discrepancy items and one life-as-a-whole item). In the present study the life-as-a-whole (MDT1) item, the first item in the questionnaire, was chosen as an indicator of global perceived QOL while the seven global discrepancy items were used as predictors of QOL.

A 7-point Likert scale was used to obtain data relevant to the seven discrepancy variables. The scale is an adaptation of the D-T Scale that was central to the work of Andrews and Withey (1976). The second item in the questionnaire addresses the first discrepancy - between what one has and wants (self/wants). The global item asks "Consider your life as a whole. How does it measure up to your general aspirations or what you want?" The response categories run from not at all (1) through half as well as what you want (4) to matches or is better than what you want (7). The second discrepancy, between what one has and relevant others have (self/others), is assessed with the question, "Consider your life as a whole. How does it measure up to the average for most people your own age and sex in this area?" The response options range from far below average (1) through average (4) to far above average (7).

The third discrepancy assessing the gap between what one has and deserves (self/deserves) is measured with the item, "Consider your life as a whole. How does it measure up to the life you think you deserve?" The response categories range from far below what is deserved (1) through matches exactly what is deserved (4) to far above what is deserved (7). The fourth discrepancy, between what one has and needs (self/needs), is measured with the question "Consider your life as a whole. How does it measure up to what you think you need?" The responses run from far below what is needed (1) through matches exactly what is needed (4) to far above what is needed (7).

Assessments of the discrepancies between what one has and expected 3 years ago to have at this point in life (self/expected) were made with the question "Consider your life as a whole. How does it measure up to what you expected three years ago?" The response categories ran from extremely less (1) through about as expected (4) to extremely more (7). Assessments of the sixth discrepancy, between what one has now and expects to have 5 years in the future (self/expects), was made with the question "Consider your life as a whole. Does it offer much less now than you expect later?" The response options ranged from extremely less (1) through about the same (4) to extremely more (7). The last discrepancy, between what one has and the best one has ever had in the past (self/best) was assessed with the item "Consider your life as a whole. How does it measure up to the best in your previous experience?" The response categories ranged from _far below the previous best_ (1) through _matches the previous best_ (4) to _far above the previous best_ (7).

There has been some controversy regarding the best means of measuring these discrepancies. One method involves the researcher calculating a difference score between a respondent's assessment of the desirability of some attribute and the perceived possession of that attribute. A second method is to request the respondent to make an direct assessment of the gap between desired and actual levels of some attribute in a single item.

Campbell et al. (1976) measured the discrepancies between respondents' present situation and a number of standards of comparisons for the life domains of housing and neighborhood. The discrepancies were empirically calculated gap scores. For example, a discrepancy score for the housing domain was determined by subtracting the score for present residential satisfaction from the score of the respondent's evaluation of the best possible housing situation imaginable.

Michalos (1991a), who did not empirically derive discrepancy scores, offers sound arguments which support the utility of perceived discrepancy scores over calculated discrepancy scores. Michalos suggests that calculated discrepancy scores, or difference scores, not only have been shown to have less explanatory power than perceived discrepancy scores, but also seem incapable of capturing the psychological comparison process that respondents' go through in deriving their responses. In contrast, Andrews and Robinson (1991) and Wright (1985b) argue that a rigorous test of the MDT for predicting SWB requires measuring aspirations, perceived achievements, and current SWB, separately. This is thought to facilitate the determination of the relative predictive power of the three components for predicting overall SWB.

Edwards (1991), while acknowledging the statistical and interpretive problems with difference scores, nonetheless, suggests avoiding measures of perceived discrepancies in a single item in favor of obtaining separate measures of the components of the discrepancies. He argues that while direct measures are an attempt to avoid the problems with difference scores, there is no guarantee of a direct correspondence between what the respondent does cognitively when generating a response and what the researcher does algebraically when calculating difference scores. Moreover, Edwards (1994) points out that with perceived, as opposed to calculated gaps, the determination of the importance of the components involved in the derivation of these implicit comparisons are lost. Edwards (1994) provides an excellent discussion of a sophisticated alternate approach, based on response surface methodology, for statistically analyzing empirically derived discrepancy scores.

The controversy surrounding difference scores is scientifically important since researchers who use direct measures of discrepancies implicitly assume that the components of these discrepancies have equal effects on the dependent variable. This, indeed, may not be the case. For this study, the controversy is irrelevant because the objective is not to determine why the perceived discrepancy is given a particular rating but rather to determine the ability of this discrepancy to predict perceived QOL. Direct measures of discrepancies were obtained from CABG surgical patients because, as Michalos (1991a) suggests, it is reasonable to believe that something is lost when a gap score is empirically calculated compared to the gap score that a respondent mentally calculates. Finally, for the sake of comparability and interpretability, it was judged important to use the same items as those used by Michalos.

Perceived Health

SF-36 Health Survey

The SF-36 Health Survey was constructed for use in health policy evaluations, population surveys, clinical research, and clinical practice (McHorney, Ware, Lu, & Sherbourne, in press). The Rand Corporation's health batteries were originally designed for the Rand Health Insurance Study (HIS), an experiment of health outcome following random allocation to various insurance plans among adults aged 14-61 years (Ware & Karmos, 1976). The batteries were developed as an outcome measure to detect changes in health status as a result of health-service use within a relatively short period of time. The batteries assess physical health, physiological health, mental health, social health, and perceptions of health (Ware et al., 1980; Stewart, Ware, Brook, & Davies-Avery, 1978; Ware, Johnston, Davies-Avery, & Brook, 1979; Ware, Davies-Avery, & Brook, 1980).

The HIS was based on a sample of about 8,000 people in 2,750 families in six sites across the United States. The HIS batteries were developed after extensive research into existing measures and testing of adaptations of existing measures or of new measures. A short 20-item version of the batteries was developed but, when administered to severely ill patients, a floor phenomenon was discovered (Bindman, Keane & Lurie, 1990). Thus, most recently, a 36-item short form (SF-36) has been developed with significant improvements in the psychometric properties of the tool (Ware & Sherbourne, 1992; McHorney et al., in press).

The SF-36 measures three categories of health: (a) behavioral functioning (b) subjective well-being, and (c) general perceptions of health. Behavioral functioning is measured by limitations in physical, social, and role activities due to poor health. Subjective well-being is defined in terms of frequency and intensity of feeling states including general mental health and vitality. General health perceptions includes personal evaluations of current health status, susceptibility to illness, and health outlook.

The SF-36 is composed of subscales measuring eight health concepts: (1) physical functioning (2) role limitations due to physical problems (3) bodily pain (4) general health perceptions (5) vitality (6) social functioning (7) role limitations due to emotional problems, and (8) general mental health (see Appendix J). A single item report of perceived changes in health status is also included in the SF-36 to determine its utility.

The ten SF-36 items in the Physical Functioning subscale measure both the presence and extent of physical limitations using a three-level response continuum. The Role Functioning subscales distinguish between role limitations due to physical versus emotional health problems. Role functioning is measured by a 4-item subscale which assesses problems with work or daily activities due to physical problems. Role functioning is also measured by a 3-item subscale which explores work-related problems or limitations of daily activities as a result of emotional problems.

The SF-36 includes two questions regarding pain. The first item asks about the severity of pain and the second measures the degree of interference with normal activities due to pain. The SF-36 General Health Perceptions subscale includes five items regarding subjective assessments of current health, future health expectations, comparison to others, and susceptibility to illness. A sixth general health rating item (item 2), which asks respondents to compare their current health to their health status 1 year ago, is included in the SF-36, although it is not included in the scores of any of the eight subscales. Ware (1993) recommends that, until more data is available regarding the utility of the item, it should be analyzed as an ordinal level scale.

The Vitality subscale assesses energy level and fatigue. To minimize response set effects, two items are positively worded (pep and energy) and two items are negatively worded (worn out and tired). These items are adaptations of those used in the HIS (Ware et al., 1979; Ware, Davies-Avery & Brook, 1980).

The Social Functioning subscale includes two items which ask about the impact of either physical health or emotional problems on normal or usual social activities. The two-item subscale defines nine levels of social functioning. The five-item Mental Health subscale (MHI-5) was derived from the full-length 38-item Mental Health Inventory (MHI) used in the HIS (Ware et al., 1979). Based on factor-analytic studies of the original MHI, the MHI-5 measures four mental health dimensions: anxiety, depression, loss of emotional control, and positive affect. The MHI-5 has been used for nearly 9 years (Stewart, Hayes & Ware, 1988). The five item scale correlates 0.95 with the full-length 38-item MHI (Ware & Sherbourne, 1992).

Of the eight subscales of the SF-36, the five-item MHI has been most extensively evaluated. The five items, each with an internal consistency reliability of 0.64, achieved a scale score reliability of 0.90 when aggregated using the method of summated ratings. Estimates of score reliability for the SF-36 subscales have been reported in 14 studies (Ware, 1993). For each scale, the median of the reliability coefficients across studies equals or exceeds 0.80, with the exception of the Social Functioning subscale (the median for this two-item subscale is 0.76). Most of these studies reported Cronbach's coefficient alpha.

To test the reliability and validity of the SF-36 Health Survey in a random sample of 1,582 British patients in two general practice clinics, Brazier et al. (1992) administered the instrument through a mail survey. The internal consistency (Cronbach's alpha) estimates ranged from 0.73 for the Social Functioning subscale to 0.96 for the Role Functioning subscales and the Vitality subscale. Moreover, the researchers provided evidence of construct-related validity in that the distribution of scores by age, sex, social class, and for patients with chronic diseases conformed to what might be expected. For example, significant age gradients were found for physical functioning and pain, but little or no gradient was found for mental health.

Using the internal consistency method, the reliability of the SF-36 has been estimated for 24 subgroups of patients participating in the Medical Outcomes Study (MOS) conducted in three cities (Boston, Chicago, and Los Angeles) (Ware, 1993). Differing in diagnosis, disease severity, and sociodemographic characteristics, reliability estimates were provided for 3,445 participants. These coefficients varied across subscales and groups from 0.65 to 0.94 (Ware, 1993).

In a random sample of 13,042 British residents, internal consistency estimates for the SF-36 ranged from 0.76 for the Social Functioning subscale to 0.90 for the Physical Functioning subscale (Jenkinson, Coulter & Wright, 1993). Similarly, another group of British researchers assessed the reliability and validity of the SF-36 administered to a group of patients (N=1,317) suffering from four common clinical conditions (Garratt, Ruta, Abdalla, Buckingham & Russell, 1993). Cronbach's alpha for all eight subscales exceeded 0.80.

Two primary methods were used in validating the SF-36. The first was to assess the content validity of the SF-36 against other commonly used health survey forms. The second involved empirical methods including factor analysis, correlational studies, and criterion-related validity studies. Ware (1993) demonstrates that the SF-36 includes eight of the most frequently represented health concepts in seven other widely used health measures. Detailed content-related and criterion-related validity evidence is presented in the SF-36 Manual (Ware, 1993).

The SF-36 Health Survey was factor analyzed to test the hypothesized two-dimensional structure of the subscales. The results of the analyses revealed two major orthogonal factors or dimensions of health - Mental Health and Physical Health (McHorney, Ware & Raczek, 1993). The components were interpreted on the basis of their correlations with the SF-36 subscales. The Physical Functioning subscale had a strong correlation with the physical component of health and a weak correlation with the mental component of health. The Mental Health subscale had a strong association with the mental health component and a weak association with the physical component. Ware (1993) asserts that some subscales principally measure the physical dimension of health (Physical Functioning, Role Functioning-Physical, and Bodily Pain); others principally measure the mental component (Mental Health, Role Functioning-Emotional, and Social Functioning). Others (Vitality and General Health Perceptions) appear to measure both.

American population norms were estimated from responses to the National Survey of Functional Health Status (NSFHS), a 1990 cross-sectional survey that included the SF-36. The total designated sample for the NSFHS was 3,251 persons residing in 2,909 households (Ware, 1993, p. 10:5). The overall response rate for the mixed-mode survey (80% mail survey and 20% telephone survey) was 77.1% for a final norm sample of 2,474. Descriptive statistics are provided for this norm sample by age group, sex, and medical condition.

Ware and Sherbourne (1992) identify two potential problems of the short-form measures compared to the original full-length instrument. They are ceiling and floor effects which are, respectively, problems of large numbers of people getting the highest or lowest possible scores in one population or another. Floor effects have been demonstrated for some of the SF-20 scales in severely ill hospital patients (Bindman et al., 1990). However, Ware and Sherbourne (1992) indicate that floor effects are rare for the SF-36, even among patients with serious chronic illness. Recently, floor effects were observed only for the Role Functioning-Physical subscale and the Role Functioning-Emotional subscale (McHorney, Ware, Lu, & Sherbourne, in press). Substantial ceiling effects were also observed for the two role-disability scales (37% of respondents scored at the ceiling on Role Functioning-Physical subscale and 56% on Role Functioning-Emotional subscale) and on the Social Functioning subscale as well (46%).

Those items in the Standard Version of the SF-36 that have a recall period, ask for reports about health status during the past 30 days. The Acute Version of the SF-36 is thought to be more appropriate for studies of treatments for acute conditions. The Acute Version, used in the present study, uses a "1-week" recall period. Evaluations are currently underway on an Acute version of the SF-36 (E.

Connor, New England Medical Center, personal communication, June 30, 1992).

There are at least 260 clinical trials using the SF-36 to assess perceived general health outcomes. The SF-36 has also been used successfully in various clinical settings and patient populations (McHorney, Ware, Rogers, Raczek & Lu, 1992; Kantz, Harris, Levitsky, Ware, & Davies, 1992; Nerenz, Repasky, Whitehorse, & Kankonen, 1992; Kurtin, Davies, Meyer, DeGiacomo, & Kantz, 1992; Lansky, Butler, & Waller, 1992; Phillips & Lansky, 1992; Stewart et al., 1989).

McHorney et al. (1992) used the known groups method to explore the discriminant validity and relative precision of four health status measures including six of the eight subscales of the SF-36. Precision was defined as the usefulness of a measure in making clinical comparisons under the conditions of a given study. A research objective was to determine how precisely each instrument discriminated between relatively well adult patients (N=638) from those with severe chronic medical (N=168) and psychiatric (N=163) conditions.

The internal consistency reliability estimates of the six SF-36 subscales over the entire sample (N=969) were: Physical Functioning (0.93), Role Functioning-Physical (0.84), Role Functioning-Emotional (0.83), Bodily Pain (0.82), Social Functioning (0.85), Mental Health (0.90), and General Health Perceptions (0.78). As hypothesized, the researchers found that differences in physical illness were best detected by the Physical Functioning, General Health Perceptions, and Role Functioning-Physical subscales. Differences in severity of psychiatric disorders were best detected by the Mental Health subscale and the Role Functioning-Emotional subscale. The Social Functioning and Bodily Pain subscales discriminated equally well between medical and psychiatric conditions.

The SF-36 was used to assess the health status of 66 patients who had undergone total knee replacements (Kantz et al., 1992). The internal consistency reliability estimates of the SF-36 subscales ranged from 0.77 for the Social Functioning subscale to 0.90 for the Role Functioning-Physical subscale. All of the subscales correlated significantly with one another but a weak correlation between the Physical Functioning and the Mental Health subscales was observed. Nerenz et al. (1992) also found a weak correlation between these two subscales in a group of adult diabetics.

The SF-36 was administered as a component of a clinical outcomes assessment program in an outpatient dialysis unit (Kurtin et al., 1992). Internal consistency reliability estimates of the SF-36 were calculated for one of the three groups of hemodialysis patients (N=39) to which it was administered. The estimates ranged from 0.62 for the Vitality subscale to 0.90 for the Physical Functioning and Role Functioning-Emotional subscales.

The SF-36 was recently administered to 305 patients attending a back pain clinic (Lansky et al., 1992). Of those patients, 113 also completed the SF-36 at a 3 month follow-up. During the initial assessment, significant deficits were observed on the Role Functioning-Physical and Bodily Pain subscales. Patients reported significant improvements in both areas at the 3 month assessment.

Phillips and Lansky (1992) administered the SF-36 to 100 patients before and again 1 and 6 months after heart valve replacement surgery. Prior to surgery patients scored below the norm on all eight subscales; scores were especially low on five subscales (Physical Functioning, Role Functioning-Physical, Vitality, Social Functioning, and Role Functioning-Emotional). These patients remained below the norm on all subscales except for the General Health Perceptions subscale 1 month after the valve replacement. Six months after surgery, the patients scored at or above the norm values for all but the Role Functioning-Physical and Role Functioning-Emotional subscales.

Scoring. In this study all SF-36 subscales were scored so that a high score defines a more favorable health state. Twenty-six of the items are scored equal to the numbers circled in the questionnaire. Item recoding was required for 10 items and 2 of these 10 items were also rescaled so that the response intervals were more equal. The other 8 items simply required reversed polarities. Responses to item 7 were recoded so that 1=6.0, 2=5.4, 3=4.2, 4=3.1, 5=2.2, and

6=1.0. Responses to item 1 were recoded so that 1=5, 2=4.4, 3=3.4, 4=2.0, and 5=1.0.

Item scores for all items in the same scale were then summed. Each scale was then transformed so that the scores range from 0 to 100. Scores between 0 and 100 represent the percentage of total possible score achieved. The formula for each Transformed Scale Score (TSS) is:

$$\text{TSS}= \frac{\text{Raw scale score - lowest possible score}}{\text{possible score range}} \times 100$$

Data Collection Procedures

Between September 8, 1992 and June 18, 1993, when CABG surgical patients meeting the inclusion criteria returned for their first follow-up visit, they were met by the investigator who explained the study and requested their participation prior to a physical assessment by the cardiothoracic surgeon. If the patient agreed to participate, an informed consent was signed and a copy given to the patient. Data was collected regarding the patients' biographical characteristics and medical history (see Appendix K).

At the follow-up visit the patients completed the measures of perceived QOL, the SF-36 Health Survey, the life domain satisfaction questionnaire, and the MDT questionnaire. The time needed to complete these questionnaires ranged from 35 minutes to 2 hours. Once patients had completed the questionnaires, a physical assessment was completed by the cardiothoracic surgeon. The patients, their medical records, and their health care providers were used to obtain information regarding postoperative complications and rehospitalizations.

Hypotheses

The hypotheses formulated for this study included:

1. Perceived global QOL can validly be measured by five instruments: the MTD1 item, the Faces Scale, the SASS, the Life Satisfaction item, and the Life 3 Scale.
2. Perceived health, measured by the following eight subscales of the SF-36 Health Survey, directly influences perceived global QOL: Physical Functioning, Role Functioning-Physical, Bodily Pain, General Health Perceptions, Vitality, Social Functioning, Role Functioning-Emotional, and Mental Health.
3. Perceived global QOL is a function of the following 7 perceived discrepancies of the MDT: between what one has and what one wants, what relevant others have, the best one has had in the past, what one expected to have 3 years ago, what one expects to have after 5 years, what one deserves, and what one needs.
4. The aspiration-achievement gap, that is, the perceived discrepancy between what one has and wants is a mediating variable between all other perceived discrepancies and perceived global QOL.
5. Perceived global QOL is directly influenced by the

reported satisfaction with family life, the satisfaction with health, the satisfaction with friends, and the satisfaction with self.

Operational Definitions

Age refers to the number of years between the respondents' birth date and the date of their first follow-up visit.

Aspiration-achievement gap (WANTS) refers to the discrepancy between what one has and what one wants which, in turn, is thought to be a function of 6 other discrepancies (what one has and what others have, between what one has and the best one has ever had, between what one has and what one deserves, between what one has and what one needs, between what one has and what one expects to have in 5 years, and between what one has and one expected to have 3 years ago) (Michalos, 1991a).

Bodily Pain (BP) refers to the intensity of bodily pain and the extent of interference with normal activities due to pain as measured by the Bodily Pain subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Canadian Cardiovascular Society Angina Classification (CCS) refers to a classification of angina pain measured on a 4 point ordinal scale (Campeau, 1976; Pollick, 1993).

Coronary Artery Bypass Graft (CABG) Surgery refers to a surgical procedure involving the construction of new conduits between the aorta (or other major arteries) and segments of coronary arteries beyond stenosed lesions to enhance myocardial blood flow (Shinn, 1992; Rosborough, 1993).

Education refers to the reported number of years of formal instruction obtained and is measured using ordinal categories.

General Health Perceptions (GH) refers to the personal evaluation of current health, health outlook, and resistance to illness as measured by the General Health Perceptions subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Hospitalizations refers to the number of times an individual is admitted to hospital after the original CABG surgery.

Mental Health (MH) refers to an assessment of the 4 major mental health dimensions (anxiety, depression, loss of behavioral/emotional control, and psychological well-being) measured by the 5-item Mental Health subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Perceived Global Quality of Life (QOL) is defined as the satisfaction with life overall as measured by MDT1 (Michalos, 1991a), the Life Satisfaction item (Campbell et al., 1976), the Life 3 Scale (Andrews & Withey, 1976), the Faces Scale (Andrews & Withey, 1976), and the SASS (Cantril, 1965).

Physical Functioning (PF) refers to the presence and extent of physical limitations measured by 10 items of the Physical Functioning subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Role Functioning-Emotional (RE) refers to role limitations as a result of emotional problems; this includes limitations in the kind of work or other usual activities, cutting down on the amount of time spent in work or other usual activities and difficulty performing work or other usual activities as measured by 3 dichotomous items of the Role Functioning-Emotional subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Role Functioning-Physical (RP) refers to role limitations resulting from physical health problems. The limitations include having difficulty performing activities, being limited in the kind of activities performed, accomplishing less than desired, and a reduction in time spent on work or other activities as measured by 4 dichotomous items comprising the Role Functioning-Physical subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Satisfaction with family life (Family) refers to the reported satisfaction with family life including the time spend in family activities as measured by two Likert-type items, one on the satisfaction Scale and one on the D-T Scale (Campbell et al., 1976; Andrews & Withey, 1976).

Satisfaction with friends (Friends) refers to the reported satisfaction with time spent with friends, the number of friends, and the activities engaged in with friends as measured by two 7-point items, one on the Satisfaction Scale and one on the D-T Scale (Campbell et al., 1976; Andrews & Withey, 1976).

Satisfaction with health (Health) refers to the reported satisfaction with current health as measured by two Likert-type items, one on the Satisfaction Scale and one on the D-T Scale (Campbell et al., 1976; Andrews & Withey, 1976).

Satisfaction with self (Self) refers to the reported satisfaction with self as measured by two 7-point items, one on the Satisfaction Scale and one on the D-T Scale (Andrews & Withey, 1976; Campbell et al., 1976).

Sex refers to the gender of the individual and is measured as a dichotomous variable.

Social Functioning (SF) is measured by 2 items of the SF-36 Social Functioning subscale which determines the perceived impact of either physical health or emotional problems on normal or usual social activities (Ware & Sherbourne, 1992; Ware, 1993).

Vitality (VT) refers to the individual’s energy level and fatigue as measured by the 4-item Vitality subscale of the SF-36 (Ware & Sherbourne, 1992; Ware, 1993).

Data Analysis

The techniques used to analyze the data of this study are briefly outlined in the following paragraphs. Results of the analyses are described in detail in Chapters IV through VIII. Chapter IV provides data analysis results regarding the measurement of perceived global QOL. The results of the analysis of the relationship between perceived health and perceived QOL are discussed in Chapter V. An evaluation of the predictive power of the Multiple Discrepancies Theory (MDT) concepts in accounting for perceived QOL is provided in

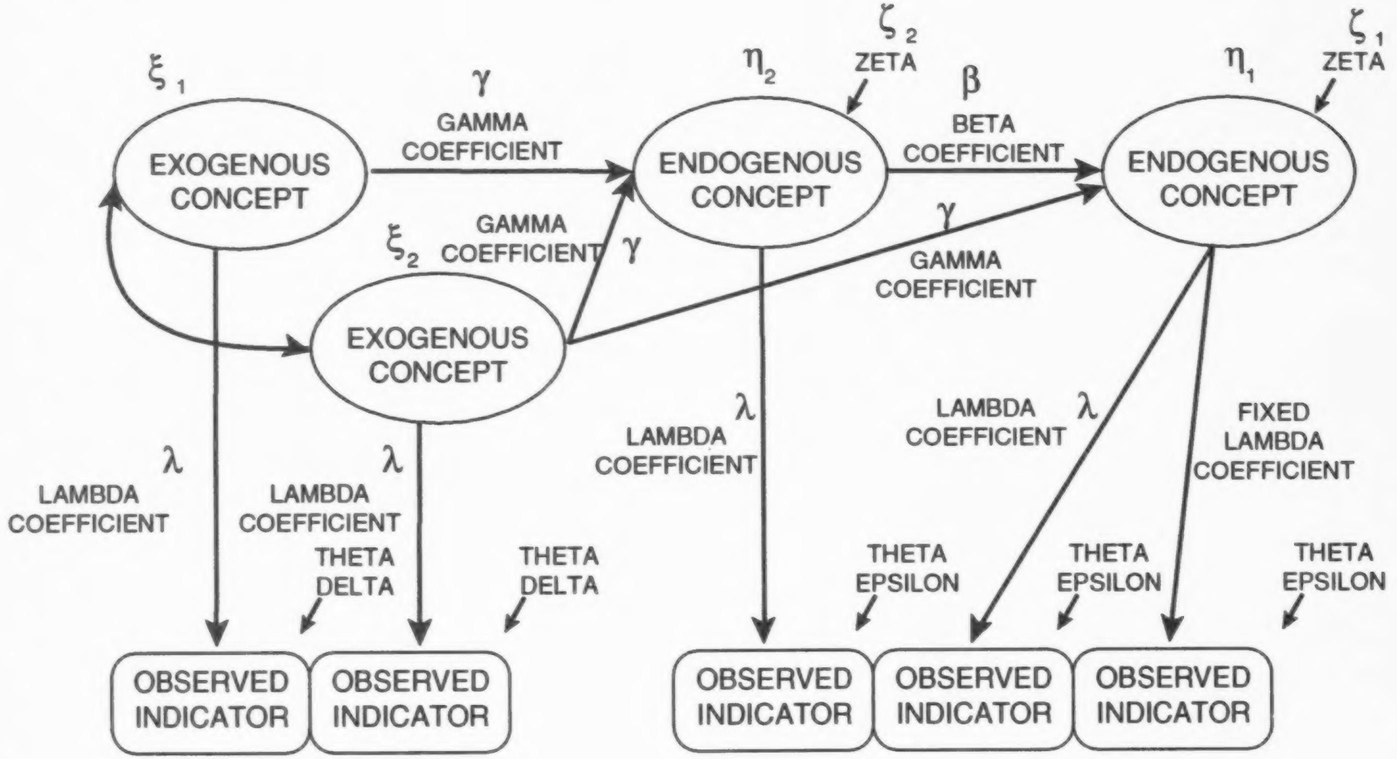
Chapter VI. The effects of the satisfaction in four life domains on overall perceived QOL is assessed in Chapter VII. Finally, Chapter VIII presents the evaluation of a model which examines simultaneously only the most predictive components of all prior models.

Descriptive statistics are generated for each of the indicators used to measure and predict perceived global QOL. Descriptive statistics are also generated for selected demographic and clinical variables. A number of correlation matrices are provided - for the QOL indicators, for the perceived health survey subscales, for the MDT indicators, and for the satisfaction with life domains indicators.

The purpose of this study is to evaluate four explanatory models (equivalent to the stated hypotheses) of the perceived global QOL of CABG surgical patients. Models are, by definition, simplifications of underlying processes (Tanaka, 1993). As such, the objective of this study is to determine the plausibility of these models of perceived QOL by examining the consistency between the theoretical models and the sample data. The LISREL (LInear Structural RElationships) computer program (Joreskog & Sorbom, 1988) is used to analyze the sample covariance matrix constructed from the data obtained in this study.

When specifying a LISREL model (see Figure 3.1), the independent variables (such as age and sex whose covariances are not explained by the model) are called exogenous

Figure 3.1 LISREL MODEL SPECIFICATION


ξ_1
EXOGENOUS CONCEPT
ξ_2
EXOGENOUS CONCEPT
η_2
ENDOGENOUS CONCEPT
ζ_2
ZETA
η_1
ENDOGENOUS CONCEPT
ζ_1
ZETA
γ
GAMMA COEFFICIENT
GAMMA COEFFICIENT γ
β
BETA COEFFICIENT
γ
GAMMA COEFFICIENT
λ
LAMBDA COEFFICIENT
λ
LAMBDA COEFFICIENT
λ
LAMBDA COEFFICIENT
LAMBDA COEFFICIENT λ
FIXED LAMBDA COEFFICIENT
THETA DELTA
THETA DELTA
THETA EPSILON
THETA EPSILON
THETA EPSILON
OBSERVED INDICATOR
OBSERVED INDICATOR
OBSERVED INDICATOR
OBSERVED INDICATOR
OBSERVED INDICATOR

variables and are represented by the Greek letter xi. Dependent variables, also known as endogenous variables, such as perceived QOL, whose variances and covariances the model is attempting to explain, are represented by the Greek letter eta. The latent variable or concept variable (exogenous or endogenous) is the formal representation of a concept (Bollen, 1989). The beta structural coefficients are the estimated effects between the endogenous variables, and the gamma structural coefficients represent the estimated effects of the exogenous on the endogenous concepts.

The measurement model describes the connections between the conceptual or latent variables to their observed indicators (Hayduk, 1987, p. 92). The elements of the lambda matrices are structural coefficients (effects) linking the latent variables (concepts) to their indicators. Given the lack of precision of most global QOL measures, an important advantage of LISREL is that it permits the researcher to provide more accurate construct-related validity evidence by specifying a specific proportion of measurement error for the observed indicators.

Errors in the measurement of the endogenous concepts are contained in the theta epsilon matrix, and errors in the measurement of the exogenous concepts are contained in the theta delta matrix. These are disturbances that disrupt the relation between the concepts and their observed indicators. Ignoring measurement error in the indicators leads to inconsistent estimators and to inaccurate assessments of the connections to the underlying concepts. The phi matrix contains the covariances among the exogenous concepts, and the psi matrix reflects errors in the prediction of the endogenous concepts by other concepts in the model.

LISREL "permits the comparison of the model-implied variances and covariances of the observed indicators to the variances and covariances calculated from the data on the observed indicators" (Hayduk, 1987, p. 107). LISREL was used to provide estimates of the relationships between the concepts suggested by theory, and to determine the adequacy of the indicators of the concepts by examining the magnitude and effect of random measurement error.

A chi square test is used to determine if the observed discrepancies between the empirical covariances and those implied by the model are due to sampling variation or if they are due to model misspecification. Bollen and Long (1993) advise against using the chi square statistic as the only criteria for judging model fit in favor of guidance from strong substantive expertise. In the absence of the benefit of good theoretical hypotheses, all available fit statistics ought to be examined in assessing the fit of a model.

The power of structural equation modeling is the ability to reject models that are inconsistent with the data. However, even if there is a perfect match between the model predicted covariance matrix and the sample covariance matrix, the model can still be incorrect. To provide construct-related validity evidence of any model of the theorized predictors of perceived QOL, at the very least, the empirical match between the model and data should be within the sampling error. The failure to find model-data consistency ought to lead to the rejection of the model and a continued search for a model which plausibly captures the hypothesized mechanisms of how CABG surgical patients come to evaluate the quality of their lives.

Model building and modification is a process of successive approximations (Bollen, 1989, p. 71). Because of the approximate nature of models and the impossibility of directly observing causality, all causal inferences must be regarded as tentative. In this study, LISREL provided tentative empirical construct-related validity evidence for a number of the hypothesized effects of a variety of constructs on QOL. In doing so, LISREL permitted a movement beyond description of scores to an explanatory scheme delineating some of the connections among the concepts. LISREL was enlightening in confirming and rejecting certain theoretical hypotheses regarding the process of how one sample of CABG surgical patients perceived QOL.

Summary

A pre-experimental survey design was used to measure and predict the perceived QOL of CABG surgical patients. A convenience sample was used, consisting of 306 western

Canadian patients. During face-to-face interviews at the first surgical follow-up visit, five instruments measuring QOL were administered to all subjects in addition to a 36-item health survey, a satisfaction with life domains questionnaire, and a 7-item instrument measuring perceived discrepancies between the current life state and a set of personal standards. Biographical data and clinical health information were also collected and analyzed. A series of descriptive and inferential statistics were generated and findings are described in Chapters IV through VIII.

IV. THE MEASUREMENT STRUCTURE OF QUALITY OF LIFE

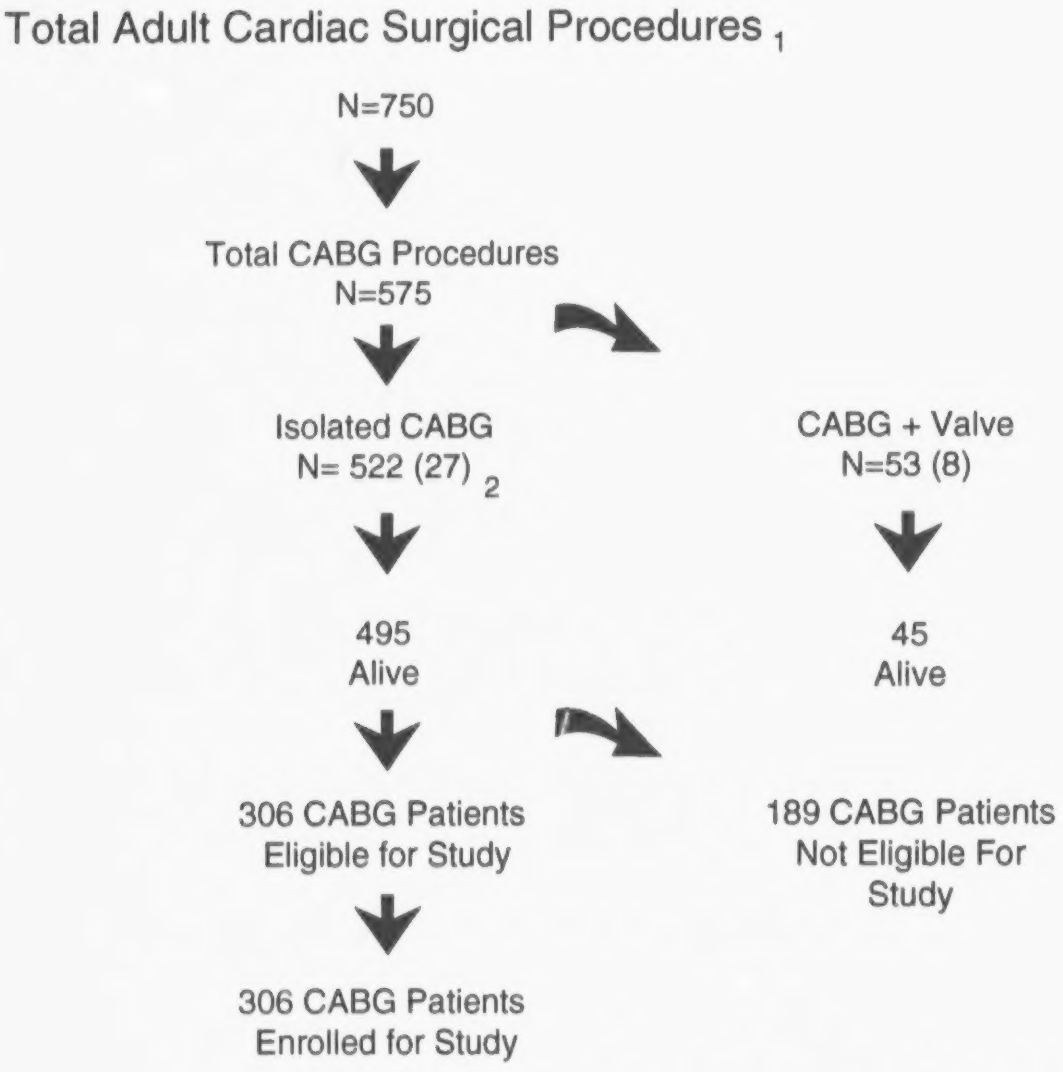
Introduction

This chapter presents the demographic and clinical characteristics of the study sample including a preoperative risk profile, the surgical data, and an account of the postoperative complications. The demographic and clinical data provide context for subsequent structural equation models. The dependent measures of QOL are then reviewed. This is followed by a discussion of the relationship of the dependent measures to the conceptualization of QOL. Finally, five LISREL models of the measurement structure of QOL are evaluated.

Characteristics of The Sample

During the designated study period, 575 CABG surgical procedures were performed by five cardiothoracic surgeons at a large western Canadian teaching hospital. Of the surviving patients, 189 were not eligible for participation in the study for various reasons including previous cardiac operations, CABG surgical procedures combined with other cardiac procedures, and inability to read or write english (see Figure 4.1). All of the 306 patients meeting the specified inclusion criteria agreed to participate in the research project. After informed consent was obtained, complete data was collected for all 306 participants by August, 1993.

Figure 4.1 Sampling Procedure


Total Adult Cardiac Surgical Procedures 1
N=750
Total CABG Procedures
N=575
Isolated CABG
N= 522 (27) 2
CABG + Valve
N=53 (8)
495
Alive
45
Alive
306 CABG Patients
Eligible for Study
189 CABG Patients
Not Eligible For Study
306 CABG Patients
Enrolled for Study

1 - Surgery Between 06-July-1992 and 13-May-1993
2 - Surgical Mortality Is Indicated In Parentheses

Demographic and Clinical Characteristics

Table 4.1 reveals that most of the study participants were caucasian (95.4%), married (79.4%), males (85%), between the ages of 40 and 75 (81.4%) living within the city of Edmonton, Alberta, Canada (53.9%). The mean age of the participants was 61.8 years with a standard deviation of 9.7 years. The majority of the participants had attained a formal education level of at least high school (70.1%) and 43 patients had received a university degree (see Table 4.2). Most of the patients were either employed full-time (35%) or retired (47.1%) at the time of surgery. Moreover, most patients were employed in or retired from service occupations (17%), administrative or managerial occupations (15.4%), construction (12.1%) and farming (10.5%) occupations.

Table 4.1

Demographic Characteristics Of CABG Surgical Patients

Variable	Frequency	Percent
Gender		
Male	260	85.0
Female	46	15.0
Total	306	100.0
Marital Status		
Married	243	79.4
Common-Law	9	2.9
Single	13	4.2
Widowed	25	8.2
Separated	4	1.3
Divorced	12	3.9
Race		
Caucasian	292	95.4
Black	3	1.0
Asian	11	3.6
Residence		
Edmonton	165	53.9
Alberta-Other	130	42.5
British Columbia	4	1.3
Saskatchewan	4	1.3
Other	3	1.0
Age at Surgery		
30-39	8	2.6
40-49	33	10.8
50-59	71	23.2
60-69	126	41.2
70-79	65	21.2
80-89	3	1.0
Mean Age 61.8		
Standard Deviation 9.7		
Range 51.1		

Table 4.2

Demographic Characteristics of CABG Surgical Patients

Variable	Frequency	Percent
Education		
Elementary Incomplete	9	2.9
Elementary Complete	8	2.6
Junior High Incomplete	46	15.0
Junior High Complete	24	7.8
High School Incomplete	67	21.9
High School Complete	61	19.9
Non-University Incomplete	2	0.7
Non-University Complete	34	11.1
University Incomplete	6	2.0
University Diploma/Certificate	6	2.0
University Bachelor Degree	29	9.5
University Professional	4	1.3
University Master Degree	8	2.6
University Doctorate	2	0.7
Occupation		
Managerial, Administrative	47	15.4
Natural Sciences, Engineering	18	5.9
Social Sciences	2	0.7
Religion	1	0.3
Teaching	12	3.9
Medicine & Health	18	5.9
Artistic, Literary	2	0.7
Clerical	8	2.6
Sales	17	5.6
Services	52	17.0
Farming	32	10.5
Fishing, Trapping	1	0.3
Forestry & Logging	2	0.7
Mining, Oil & Gas	12	3.9
Processing	1	0.3
Machining	8	2.6
Product Fabrication	4	1.3
Construction	37	12.1
Transport Equipment	13	4.2
Materials Handling	2	0.7
Other Crafts & Equipment	2	0.7
Keeping House	15	4.9
Employment		
Full-time	107	35.0
Retired	144	47.1
Unemployed/Disability	34	11.1
Part-time	6	2.0
Keeping House	15	4.9

Preoperative Risk Factor Profile

Patients at high risk for surgical mortality and morbidity include the elderly, those with severe coronary artery disease (CAD), those with left ventricular dysfunction, those with multiple concomitant medical problems, and those who require emergency surgery. Most participants waited less than a month for CABG surgery with a modal wait of 7 days and a median wait of 22 days (see Table 4.3). Of the four surgical waiting list priority categories, most patients were classified as "Urgent In House" which means that these patients were in need of surgery such that they required close monitoring in hospital. Eight percent of patients required immediate surgery and 21% were classed as elective cases.

Most patients (45.8%) were also class III according to the Canadian Cardiovascular Society Classification (CCS) for angina. Manifestations of CCS Class III angina occur when walking less than two blocks on level ground at a normal pace, under normal conditions, or when climbing one flight of stairs and this degree of angina markedly limits ordinary physical activity (Pollick, 1993). Moreover, the majority of patients (83.7%) were class II or III according to the New York Heart Association Classification (NYHA) for heart failure. NYHA class II reflects slight, and class III reflects marked, limitation of physical activity manifested as fatigue and shortness of breath. Thirteen percent of patients were unable to carry out any physical activities without symptoms of heart failure.

While about half of the participants reported a history of hypertension (50.7%), relatively few participants suffered from diabetes (16%), congestive heart failure (CHF) (1.3%), cerebrovascular accident (CVA) (2.3%), chronic obstructive pulmonary disease (COPD) (4.2%), peripheral vascular disease (PVD) (1.3%) or renal failure (0.7%). As shown in Table 4.3, a number of participants (18.3%) had suffered a myocardial infarction (MI) within 30 days of surgery and one patient had suffered two. A larger proportion of participants (43%) had suffered a remote MI; thirty five percent of participants had suffered one MI longer than 30 days prior to surgery and a few patients (7.8%) had suffered two or three MIs in the past.

A small number of patients (9.2%) had undergone a successful percutaneous transluminal coronary angioplasty (PTCA) of one or more coronary arteries, a median of 233 days prior to CABG surgery. Fewer patients (5.9%) had experienced a failed PTCA of one or two coronary arteries prior to surgery and 8 of these patients required urgent CABG surgery within a week of the PTCA (see Table 4.4). Ejection fraction (EF), an objective determinant of ventricular contractility, was calculated at the time of the patient's preoperative cardiac catheterization (biplane ventricular angiogram). Most patients (78.4%) had an EF of between 45 and 75 percent, however, a number of patients (21.9%) had an EF of less than 40% which indicates poor myocardial pumping efficiency.

Most patients (74%) had a history of smoking cigarettes and 34.1% of these patients had stopped smoking within the year prior to surgery. Patients who had stopped smoking did so a median of 6.66 years prior to surgery. The number of years the patient had smoked and the number of cigarettes smoked per day was recorded in order to calculate the number of pack-years smoked. The proportion of a package of 25 cigarettes usually smoked per day was multiplied by the total number of years smoked to obtain pack-years. For example, if a patient smoked 1 package of cigarettes per day for 15 years, the number of pack-years that patient had smoked was (1.0 x 15) = 15. Of the 226 patients with a history of cigarette smoking, 81% of these smoked less than 50 pack-years and only 25% smoked less than 20 pack-years.

Table 4.3

Preoperative Clinical Risk Profile Of CABG Surgical Patients

Variable	Frequency	Percent
Days Waited For Surgery		
0-29	159	52.0
30-59	22	7.2
60-89	25	8.2
90-119	16	5.2
120-149	18	5.9
150-179	14	4.6
180-209	11	3.6
210-239	7	2.3
240-269	6	2.0
270-299	0	0.0
>300	28	9.1
Mean	94.5	
Mode	7.0	
Median	22.5	
Standard Deviation	143.2	
Waiting Priority		
Emergency	24	7.8
Urgent In Hospital	122	39.9
Urgent Out of Hospital	97	31.7
Planned	63	20.6
Canadian Cardiovascular Society Classification (CCS)		
I	8	2.6
II	75	24.5
III	140	45.8
IV	83	27.1
New York Heart Association Classification (NYHA)		
I	11	3.6
II	130	42.5
III	126	41.2
IV	39	12.7
Hypertension	155	50.7
Myocardial Infarction - Remote	133	43.4
Myocardial Infarction - Recent	57	18.6
Diabetes	49	16.0
COPD	13	4.2
Cerebrovascular Accident	7	2.3
Peripheral Vascular Disease	4	1.3
Congestive Heart Failure	4	1.3
Renal Failure	2	0.7

Table 4.4

Preoperative Clinical Risk Profile Of CABG Surgical Patients

Variable	**Frequency**	**Percent**
Percutaneous Transluminal Coronary Angioplasty - Successful		
1 vessel	16	5.2
2 vessels	7	2.3
3 vessels	2	0.7
4 vessels	2	0.7
5 vessels	1	0.3
Percutaneous Transluminal Coronary Angioplasty - Failure		
1 vessel	15	4.9
2 vessels	3	1.0
Ejection Fraction (%)		
20-29	15	4.9
30-39	41	13.4
40-49	58	18.9
50-59	69	22.5
60-69	69	22.5
70-79	44	14.4
80-89	10	3.3
Mean	53.94	
Mode	70	
Range	65	
Pack-Years Smoked		
Never smoked	80	26.1
0-9	23	7.5
10-19	33	10.8
20-29	47	15.4
30-39	43	14.0
40-49	37	12.1
50-59	17	5.5
60-69	11	3.6
70-79	9	2.9
>80	6	1.8

Surgical Data

The total length of hospital stay was defined as the length of time between the patient's admission to hospital (for any reason) and the patient's discharge from hospital after CABG surgery. The majority of patients (59.5%) had a total length of stay of between 6 and 9 days. The mean total length of stay was 10.4 days with a range of 60.3 days. A surgical length of stay was calculated to more accurately reflect the effect of CABG surgery on length of hospitalization. The surgical length of stay was the length of hospitalization between the start of the surgical procedure and the patient's hospital discharge. The mean surgical length of stay was 7.6 days with a range of 46 days. The intensive care unit (ICU) length of hospital stay was calculated as the time between a patient leaving the operating theatre and the patient's discharge from the ICU to a cardiothoracic surgical nursing ward. The mean ICU length of stay was 1.6 days with a range of 13.45 days. The modal ICU length of stay was 0.99 days (see Table 4.5).

Most patients (70.3%) underwent revascularization of 3 or 4 coronary arteries. The modal number of vessels grafted was 3 with a range of 5. The cardiopulmonary bypass (CPB) time is calculated as the time the patient's cardiovascular circulation is supported on the heart-lung machine while surgery is in progress. The mean CPB time was 93.6 minutes with a range of 215 minutes. The aortic cross clamp time is, very briefly, a reflection of the time needed for the revascularization procedure. During aortic cross clamp the heart, which is not beating, is functionally separated from the cardiovascular circulation. The mean aortic cross clamp time was 50 minutes with a range of 119 minutes (see Table 4.6).

Table 4.5

Surgical Variables For CABG Surgical Patients

Variable	Frequency	Percent
Total Length of Hospital Stay		
4-5 Days	30	9.8
6-7 Days	141	46.1
8-9 Days	41	13.4
10-11 Days	25	8.2
12-13 Days	22	7.2
14-15 Days	11	3.6
16-17 Days	6	2.0
18-19 Days	2	0.6
20-21 Days	4	1.3
22-23 Days	3	0.9
> 23 Days	21	6.9
Mean	10.4	
Mode	6.0	
Range	60.3	
Surgical Length of Hospital Stay		
3-4 Days	42	13.7
5-6 Days	166	54.2
7-8 Days	47	15.4
9-10 Days	20	6.5
11-12 Days	10	3.3
13-14 Days	4	1.3
15-16 Days	5	1.6
17-18 Days	1	0.3
19-20 Days	2	0.6
21-22 Days	1	0.3
> 22 Days	8	2.6
Mean	7.6	
Mode	5.1	
Range	46.0	
Intensive Care Unit Length of Stay		
0-1 Days	250	81.7
2-3 Days	43	14.0
4-5 Days	9	2.9
6-7 Days	1	0.3
> 7 Days	3	1.0
Mean	1.57	
Mode	0.99	
Range	13.45	

Table 4.6

Surgical Variables For CABG Surgical Patients

Variable	Frequency	Percent
Number of Grafts		
1	9	2.9
2	66	21.6
3	120	39.2
4	95	31.0
5	14	4.6
6	2	0.7
Mode	3	
Range	5	
Cardiopulmonary Bypass Time (minutes)		
0-49	24	7.8
50-99	155	50.6
100-149	111	36.3
150-199	14	4.6
200-249	2	0.6
Mean	93.58	
Standard Deviation	34.39	
Mode	66.00	
Aortic Cross Clamp Time (minutes)		
0-29	53	17.3
30-59	154	50.3
60-89	89	29.1
90-119	9	2.9
120-149	1	0.3
Mean	50.03	
Standard Deviation	20.63	
Mode	34.00	

Postoperative Complications

Most of the postoperative complications occurred during the first week after the patients' CABG surgery. The complications which occurred are listed, in descending order of frequency, in Table 4.7. The most commonly experienced complication was an infection in the donor leg incision (15.7%). From the patients' perspective, this complication was the most bothersome because the discomfort from the incisional infection restricted their mobility. The second most frequent complication was a sternal wound infection (6.2%); this complication was less disabling in the patients' view.

A mechanical cardiac assist device, either an intra-aortic balloon pump (IABP) or a left ventricular assist device (LVAD) had to be placed in 5.6% and 0.3% of patients, respectively. These devices were required to assist the surgeon to remove the patient from the heart-lung machine after the surgical procedure was completed. Hemorrhage, requiring a return to the operating theatre for control, occurred in 4.6% of patients. Two patients suffered a cerebrovascular accident (CVA) in the postoperative period (after the first surgical follow-up visit) and 3 patients suffered an MI either during or after surgery.

The following complications were observed either during the surgical hospitalization or after hospital discharge: cardiac arrest or ventricular fibrillation (VF) (1.6%), deep vein thrombosis (DVT) (0.7%), congestive heart failure (CHF) (2.9%), pulmonary embolus (1.0%), renal failure (0.3%), respiratory failure (1.6%), pneumonia (2.0%), ulnar nerve damage (2.0%) and hemidiaphragm (0.7%). Two patients required a permanent pacemaker insertion after CABG surgery and five patients returned to the operating theatre because of a sternal incision dehiscence. More seriously, nine patients experienced closure of their grafts and of these, four patients had to undergo PTCA of their stenosed grafts. One patient underwent a repeat CABG 16 months after the original procedure. Without prompting from the investigator, 15 patients expressed concern about a noticeable short-term memory loss and 16 patients judged themselves as depressed.

The demographic and clinical data just presented are useful for understanding the characteristics of the population from which this study sample was drawn. The quality of life outcome measures are more meaningful when interpreted in the context of the medical ordeal these patients experienced. However, these data are not included in any subsequent structural equation models of the predictors or measures of perceived QOL. The premise of this study is that it is not the objective circumstances of one's life that determines QOL so much as one's perception of that life.

Table 4.7

Postoperative Complications After CABG Surgery

Variable	**Frequency**	**Percent**
Donor Leg Infection	48	15.7
Sternal Wound Infection	19	6.2
IABP Insertion	17	5.6
Expressed Depression	16	5.2
Expressed Memory Loss	15	4.9
Hemorrhage	14	4.6
CHF	9	2.9
Graft Stenosis	9	2.9
Pneumonia	6	2.0
Ulnar Nerve Damage	6	2.0
Cardiac arrest/VF	5	1.6
Respiratory Failure	5	1.6
Sternal Wound Dehiscence	5	1.6
PTCA	4	1.3
Myocardial Infarction	3	1.0
Pulmonary Embolus	3	1.0
Cerebrovascular Accident	2	0.7
Deep Vein Thrombosis	2	0.7
Hemidiaphragm	2	0.7
Pacemaker Insertion	2	0.7
Renal Failure	1	0.3
LVAD Insertion	1	0.3

Key:

IABP = Intra-aortic Balloon Pump
LVAD = Left Ventricular Assist Device
PTCA = Percutaneous Transluminal Coronary Angioplasty
VF = Ventricular Fibrillation
CHF = Congestive Heart Failure

The Measurement of Quality of Life

In this section the dependent measures of perceived quality of life (QOL) are described and discussed. The measures were selected after a thorough review of the literature. More importantly, they were selected for their consistency with the conceptualization of QOL as a global evaluation of, or satisfaction with, one's life as a whole. Detailed descriptive statistics of each perceived QOL measure are systematically evaluated. The internal consistency of the Index of Well-Being is examined followed by a presentation of the correlation matrix of the indicators of perceived QOL.

Five measures of global perceived QOL were selected for this study. They include the Life Satisfaction item (SWB11) of the Index of Well-Being (IWB) (Campbell et al., 1976), the Life 3 Scale (Andrews & Withey, 1976), the Faces Scale (Andrews & Withey, 1976), the Self-Anchoring Striving Scale (SASS) (Cantril, 1965) and the Life-as-a-whole item (MDT1) (Michalos, 1991a). The descriptive statistics for each of these dependent measures follows a brief description of the instruments; the instruments are discussed in detail in Chapter III.

Index of Well-Being

A. Index of General Affect (IGA)

Interesting	1	2	3	4	5	6	7	Boring
Enjoyable	1	2	3	4	5	6	7	Miserable
Easy	1	2	3	4	5	6	7	Hard
Worthwhile	1	2	3	4	5	6	7	Useless
Friendly	1	2	3	4	5	6	7	Lonely
Full	1	2	3	4	5	6	7	Empty
Hopeful	1	2	3	4	5	6	7	Discouraging
Free	1	2	3	4	5	6	7	Tied Down
Rewarding	1	2	3	4	5	6	7	Disappointing
Brings out the Best in Me	1	2	3	4	5	6	7	Doesn't Give me much chance

B. Overall Life Satisfaction (SWB11)

How satisfied or dissatisfied are you with your life as a whole?

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Life 3 Scale

How do you feel about your life as a whole?

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted

This item is administered at the beginning and at the end of the interview.

Faces Scale

"Here are some faces expressing various feelings. Below each is a letter. Which face comes closest to expressing how you feel about your life as a whole?"

Smiling Face			Neutral Face			Frowning Face
A	B	C	D	E	F	G

Self-Anchoring Striving Scale (SASS)

"Here is a picture of a ladder. Suppose we say that the top of the ladder represents the best possible life for you and the bottom represents the worst possible life for you. Where on the ladder do you personally stand at the present time?"

Life-as-a-Whole Item (MDT1)

How do you feel about your life as a whole right now? Is life generally dissatisfying, satisfying, etc.?

1	2	3	4	5	6	7
Terrible	Very Dissatisfying	Dissatisfying	Mixed	Satisfying	Very Satisfying	Delightful

Descriptive Statistics

The descriptive statistics for each of the QOL measures for the CABG patients are provided in Table 4.8 and Table 4.9. The patients' mean score on the Life-as-a-Whole item (MDT1) was 5.10. The distribution of this item was negatively skewed as were all the QOL measures. Patients avoided the lower extreme of this scale; a score of 1 was not selected by any of the patients. The mean score for the Faces Scale was 5.4, slightly higher than the MDT1 item. The patients' mean rating on the SASS was 6.8 out of a possible 10 (see Table 4.8). This is similar to the mean score of 6.6 of the American population almost 3 decades ago (Cantril, 1965). The distribution of the scores was negatively skewed with the majority of patients choosing numbers 7 and 8 out of a possible score of 10.

The Faces Scale was well received by the CABG surgical patients; they appeared to enjoy completing this instrument and they demonstrated no hesitation in answering this item. Interestingly, the Faces Scale is composed of a series of faces with expressions ranging from a big smile to a serious frown. That is, no words are used to describe the faces.

Recently, Lance and Sloan (1993) found that in a confirmatory factor analysis, using LISREL to assess measurement reliability and common methods variance on estimates of overall - life domain satisfaction relationships, the Faces Scale interjects less common method variance than the D-T Scale format. Moreover, they provide evidence that these scale formats comprise different measurement methods of the same construct rather than just different forms of the same measurement method.

Similarly, the SASS uses only numbers as descriptors of the rungs of the ladder. The patients choose a number which reflects the evaluation of their life as a whole after subjectively assessing their best possible and worst possible life situation. Again, this instrument was well received by the CABG surgical patients who had little difficulty generating a response. The implications for the construct-related validity of the use of instruments with and without words as a measure of perceived QOL is as yet unclear.

The IWB is the sum of (1) the average score on an Index of General Affect (IGA) and (2) a single-item assessment of overall life satisfaction. The CABG patients' mean score on the IWB was 11.56 with a negative skew (see Table 4.8). This mean score is only slightly below a mean of 11.8 for a random sample of American adults in 1972 (Campbell et al., 1976). Exploring the component parts of this instrument more closely, the mean score for the IGA was 5.45 with a standard deviation of 0.853. The IGA mean score did not include two items of the index for reasons which will be described shortly. The mean score for the single item which evaluates overall life satisfaction (SWB11) was 5.55 with a standard deviation of 1.004.

Table 4.8

Descriptive Statistics for Quality Of Life Instruments

Statistic	**MDT1**	**FACES**	**SASS**	**IWB**	**SWB11**
Possible range of each item	6	6	10	6	6
Observed range	5.00	6.00	9.00	10.25	5.00
Mean	5.10	5.43	6.80	11.56	5.55
Median	5.00	6.00	7.00	11.86	6.00
Mode	5.00	6.00	7.00	12.47	6.00
Standard Deviation	0.83	0.98	1.67	1.79	1.00
Standard error	0.05	0.06	0.10	0.10	0.06
Skewness	-0.42	-1.04	-0.76	-0.76	-0.70

n=306

The mean of the Life 1 Scale was 5.5 with a negatively skewed score distribution. The mean of Life 2 was 5.3 with a negative skew identical to Life 1 and the CABG patients' mean score on life 3 was 5.4. The CABG surgical patients did not appear to notice that they were requested to complete an identical item twice. One of the structural equation models of the measurement of QOL will test whether the respondents' memory of their scores on the first administration influenced the responses on second administration of the instrument.

Table 4.9

Descriptive Statistics for Quality Of Life Instruments

Statistic	**Life 1**	**Life 2**	**Life 3**
Possible range of each item	6	6	6
Observed range	5	5	4
Mean	5.46	5.36	5.41
Median	5.00	5.00	5.50
Mode	6.00	5.00	5.00
Standard Deviation	0.91	0.83	0.76
Standard error	0.05	0.05	0.04
Skewness	-0.48	-0.48	-0.44

n=306

The Internal Consistency of the Index of Well-Being

Prior to a discussion of the relationship between the dependent measures of QOL, a discussion of the correlation matrix of the items of the IWB is necessary. Unexpectedly, patients generally found this semantic differential instrument confusing and difficult to complete without detailed instructions from the investigator. An inter-item correlation matrix was constructed and examined because of a concern about the internal consistency reliability of this QOL instrument (see Table 4.10).

The intercorrelations of the items ranged from 0.12 to 0.62. Two of the items, with adjective pairs, easy versus hard and free versus tied down, correlated poorly with the other eight items in the instrument. This finding is consistent with those of others who have administered this tool (Molzahn, 1989; Campbell, et al., 1976). Accordingly,

Table 4.10

Correlation Matrix Of The Items of The Index of Well-Being

Variables	Interesting	Enjoyable	Easy	Worthwhile	Friendly	Full	Hopeful	Free	Rewarding	Brings Out Best in Me	Overall Life Satisfaction
Interesting	1.0										
Enjoyable	.58	1.0									
Easy	.13	.32	1.0								
Worthwhile	.46	.45	.19	1.0							
Friendly	.42	.49	.31	.33	1.0						
Full	.55	.60	.23	.42	.62	1.0					
Hopeful	.48	.48	.31	.45	.53	.58	1.0				
Free	.35	.31	.25	.12	.26	.31	.27	1.0			
Rewarding	.62	.56	.27	.46	.49	.61	.53	.39	1.0		
Brings Out Best In Me	.49	.53	.34	.46	.55	.61	.54	.34	.56	1.0	
Overall Life Satisfaction	.51	.46	.30	.39	.44	.55	.49	.30	.59	.52	1.0

n=306

these two items were excluded from the calculation of the composite score of the IGA and the IWB in this study.

The last item of the IWB, which is the only item which assesses the patient's overall satisfaction with life, was preferentially selected as an indicator of QOL because of the global, evaluative nature of the question. While one sacrifices an element of reliability by rejecting a composite score consisting of eight items in favor of a single item, one has to consider the consistency between the item and the definition of the concept it represents. The maximum alpha reliability coefficient obtained by optimally weighting the items by using the eigenvector associated with the largest eigenvalue (5.45) of the correlation matrix, for the IWB with all eight items was 0.898; with the two discrepant items removed it was 0.904.

Correlations Among The Quality of Life Measures

Correlations among the dependent variables of QOL were examined (see Table 4.11). The correlations range between 0.43 and 0.94. The highest correlation in the matrix is between the IWB composite score and the Life Satisfaction item (SWB11) of the IWB. Life 1 and Life 2 are identical questions administered at the beginning and again at the end of the face-to-face interview. The correlation between Life 1 and Life 2 is 0.54 suggesting, that the perceptions of QOL at the beginning of the interview were different than the perceptions at the end of the interview. The correlations between Life 3, and Life 1 and life 2, were 0.89 and 0.87, respectively.

The correlations between the MDT1 item, the SASS, the Life Satisfaction item, and the Life 3 scale ranged from 0.46 to 0.59. Two of these items, MDT1 and Life 3, correlated slightly stronger with each other and with the SASS and SWB11 than with the Faces Scale. These correlations are perhaps of similar magnitude because the items all measure perceived QOL in terms of a cognitive assessment of life as opposed to measures with an affective tone.

Table 4.11

Correlation matrix: Measures of Perceived Quality Of Life

Variable	**MDT1**	**FACES**	**SASS**	**IWB**	**SWB11**	**LIFE 1**	**LIFE 2**	**LIFE 3**
MDT1	1.0	.44	.52	.49	.48	.47	.58	.59
FACES		1.0	.53	.55	.47	.40	.51	.52
SASS			1.0	.52	.46	.43	.58	.57
IWB				1.0	.94	.49	.68	.66
SWB11					1.0	.43	.62	.59
LIFE 1						1.0	.54	.89
LIFE 2							1.0	.87
LIFE 3								1.0

n=306

Key

MDT1 = Life-as-a-whole
FACES = Faces Scale
SASS = Self-Anchoring Striving Scale
IWB = Index of Well-Being
SWB11 = Life Satisfaction
LIFE 1 = First administration of Life 3 Scale
LIFE 2 = Second Administration of Life 3 Scale
LIFE 3 = Mean of (Life 1 + Life 2)

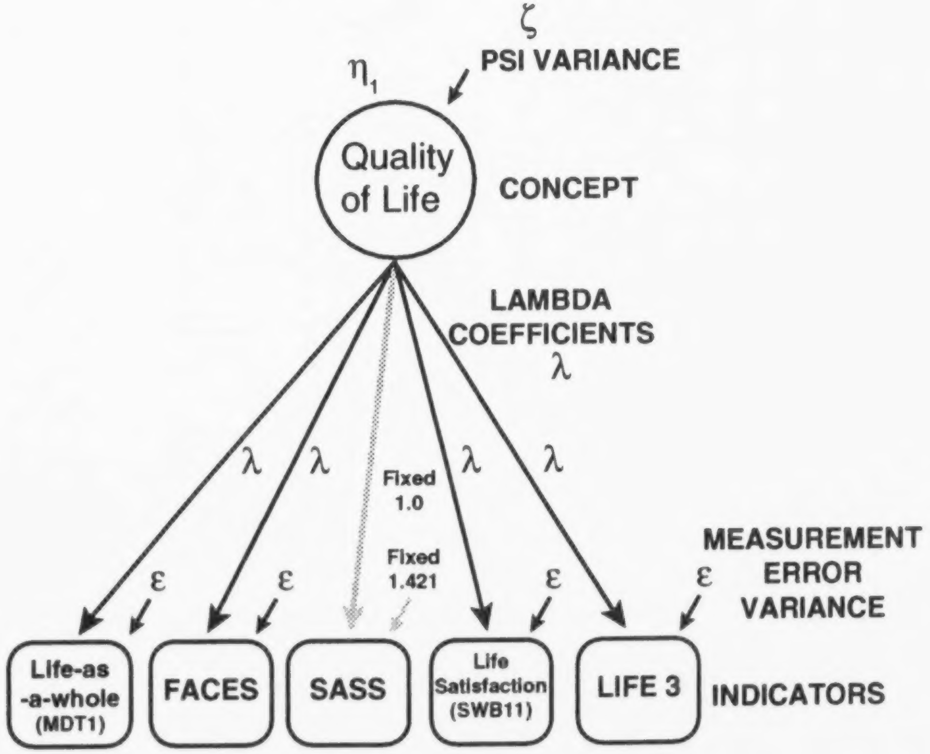
Structural Equation Models Of Measurement Of Quality Of Life

This section describes and interprets 5 models of the measurement of perceived Quality Of Life (QOL). Model 1, illustrated in Figure 4.2, is the first attempt to examine the internal consistency of the dependent measures of QOL. The data for estimating and testing this model are the covariances of the QOL indicators, discussed above, for 306 CABG surgical patients.

The model has only one concept, namely, Quality of Life. The values of this concept, which are unknown, are the true scores that each individual would have if there was no misunderstanding of the concept or the questions and if there was no purposeful deception or exaggeration. The QOL concept, a hypothetical construct that is not directly observable, is depicted as having five indicators or measures. The purpose of this measurement model is to determine how well the observed indicators serve as measurement instruments of the construct. These indicators were chosen because they most closely represent the conceptualization of QOL as a global evaluation of one's life as a whole. Because the QOL construct is not observable it does not have a definite scale. Since the QOL concept has five indicators, one of them was chosen as the scaling measure of the concept.

The concept of QOL is scaled to the SASS indicator by fixing the lambda coefficient at a value of 1.0. That is,

Figure 4.2 Model 1: Measurement of Quality of Life Parameter Specification


ζ
PSI VARIANCE
η1
Quality of Life
CONCEPT
LAMBDA COEFFICIENTS λ
λ
λ
Fixed 1.0
Fixed 1.421
λ
λ
ε
ε
ε
ε
MEASUREMENT ERROR VARIANCE
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 3
INDICATORS

$$SASS = [1.0\ (QOL) + \text{measurement error}]$$

where the 1.0 can be interpreted like a regression slope coefficient in regression analysis. A unit change on QOL is scaled to be the same as a unit change on the SASS. The 1.0 is a structural coefficient indicating how many units the SASS changes if the corresponding underlying concept QOL is changed 1.0 unit. The 1.0 guarantees that each unit of change in QOL corresponds to a unit of change in the SASS and hence guarantees that the scale on which QOL and the SASS are measured have equally sized units. This does not make the indicator SASS identical to the QOL concept because of error in the measurement of QOL. The proportion of measurement error variance is fixed at a specific value by multiplying a chosen proportion for error variance with the variance of the indicator. The remaining indicators of QOL are free to be estimated.

A model may not be identified until the scale of the concept has been established. If the scale of the concept is not established, there may exist an indeterminancy between the variance of a common factor (i.e., QOL) and the loadings of the observed variables on that factor. This makes it impossible to distinguish between the case in which a factor has a large variance and the loadings on it are small and the case in which the variance is small and the loadings on it are large.

SASS is used to scale the QOL concept because this scale requires the respondents to select an unlabeled number on a ladder. The stance taken herein is that QOL is a subjective evaluation of one's life that cannot be objectively compared to another person's QOL. Each individual has a unique set of standards by which they judge, at any given point in time, where they are in relation to those standards. Therefore, this scale was preferred as the scaling measure of QOL.

It is impossible for an outside observer to discern what another's QOL is or how it was derived. Perceived QOL is an internal, subjective assessment which undoubtedly changes many times in one's life. A change in QOL could occur as one either sets new standards of quality (higher or lower) or accommodates to an old set of standards resulting in the satisfaction with a lower standard than was once desired. As will be discussed later, even though SASS was selected as the scale for QOL, scaling QOL to several of the other indicators was almost as successful in modeling the measurement of QOL.

Measurement of Quality Of Life: Model 1

Parameter Specification

A complete copy of the LISREL computer output for the analysis of the model of the multiple measurements of QOL (see Figure 4.2) is provided in Appendix L. This output will be discussed in detail; all subsequent models will be discussed by emphasizing theoretical changes and implications in a summary fashion.

The commands for Model 1 are found on page 1 of the computer output. The command lines read by the LISREL program and the requested output are found on pages 2 and 3, respectively. The sample covariance matrix to be analyzed is found on page 4 of the computer output. This matrix was checked to ensure that the correct variables were being read.

A listing of the structural coefficients to be estimated appears on the LISREL output page 5. The numbers in these matrices indicate the locations where coefficients are free to be estimated; nine coefficients are estimated in this model. Four lambda coefficients, corresponding to slope coefficients of regression analysis, are estimated.

The two remaining matrices which complete the model specification include the variance/covariance among the two types of error terms that appear in the model: (1) unexplained variance of the QOL concept (contained in psi) and (2) errors in the measurement of the QOL concept (contained in theta epsilon). For substantive reasons, which will be documented later, the value of the theta epsilon for the SASS indicator was fixed at a specific non-zero value to specify measurement quality.

As illustrated on page 6 of the computer output, the remaining indicators of QOL are given non-zero start values to facilitate convergence of a maximum likelihood solution. While start values may facilitate a convergence, they do not determine the resulting estimates. They simply serve as a more appropriate starting value than the default value of 0 for finding an adequate solution of the model.

The values of the fitting function for the iterations LISREL produced in converging to the final estimates are found on the computer output pages 7 through 10. The fit function is progressively reduced reflecting the fact that LISREL analytically searches for the best set of estimates. The first estimates are created using two-stage least squares estimates of the coefficients. "These first guesses are then progressively improved upon using first steepest-descent iterations and then Fletcher-Powell iterations to fine tune the initial estimates." (Hayduk, 1987, p. 138). As LISREL gets close to a solution, the values of the fit function change only minimally.

Maximum Likelihood Estimates

The maximum likelihood estimates for Model 1 are found in Table 4.12 and are illustrated in Figure 4.3. The maximum likelihood estimates for Model 1 can also be found on page 11 of the Lisrel output in Appendix L. The LISREL maximum likelihood estimates are those values for the free structural coefficients which imply covariances that are as consistent as possible with the data (the input covariances). The factor loadings or lambda coefficients indicate how a unit change in the concept affects the observed indicators. For example, a unit increase of QOL results in an expected unit increase of 0.523 in the Faces Scale.

Table 4.12

Maximum Likelihood Estimates Of Model 1 of Quality Of Life

Df	6
Chi Square	9.35
p	0.155

Squared Multiple Correlations of The Indicators

MDT1	Faces	SASS	SWB11	Life 3
0.505	0.434	0.500*	0.485	0.676

Coefficient of Determination = 0.847

Lambda Coefficients

MDT1	Faces	SASS	SWB11	Life 3
0.492	0.540	1.00*	0.587	0.523

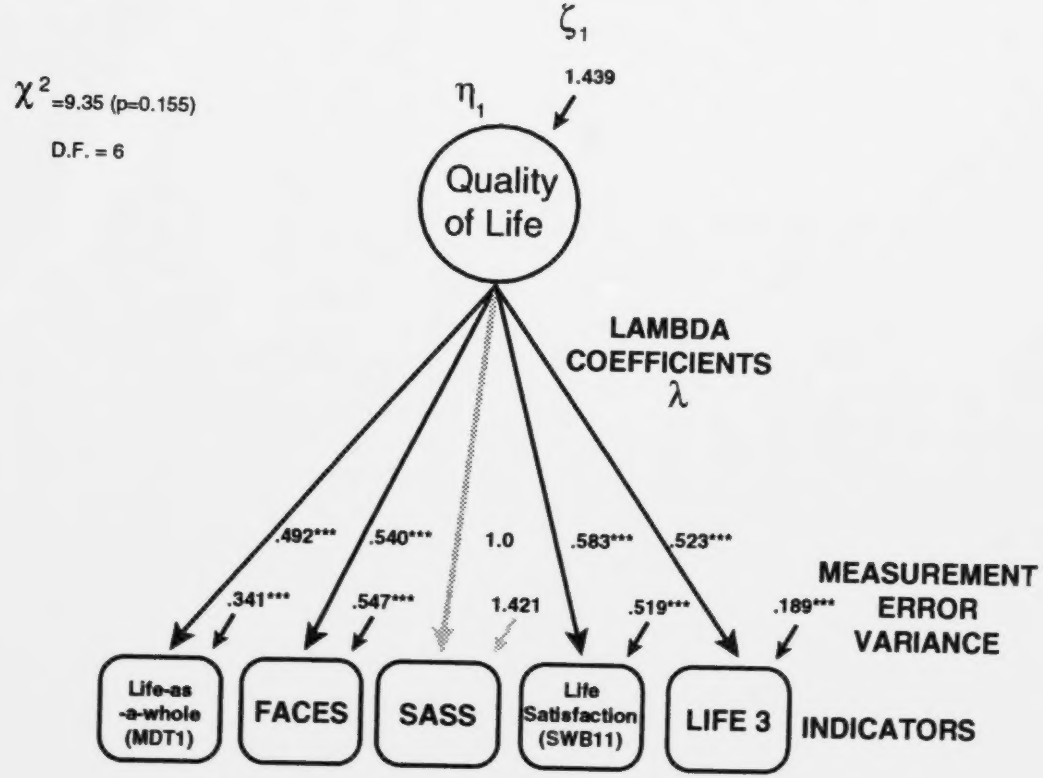
Theta Epsilon (Measurement Error Variance)

MDT1	Faces	SASS	SWB11	Life 3
0.341	0.547	1.421*	0.519	0.189

* = fixed coefficients

The theta epsilon matrix contains the estimates of error variance in the measurement of QOL. A significant amount of variance in all of the indicators of QOL is composed of error. For example, of the total variance in MDT1 (0.689), the estimated measurement error variance is 0.341 (see Figure 4.3) and 0.341/0.689 is 50% estimated error variance. Similarly, the variance of the Faces Scale is 0.968 so that the estimated percentage of measurement error variance is 0.547/0.968 = 55%. The estimated percentage of error

Figure 4.3 Model 1: Measurement of Quality of Life
Maximum Likelihood Estimates


χ^2 =9.35 (p=0.155)
D.F. = 6
ζ_1
1.439
η_1
Quality of Life
LAMBDA COEFFICIENTS
λ
.492***
.540***
1.0
.583***
.523***
.341***
.547***
1.421
.519***
.189***
MEASUREMENT ERROR VARIANCE
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 3
INDICATORS

*** = p<0.05

variance of SWB11 and Life 3 are 51% and 32%, respectively. The psi matrix contains the error variance (1.439) in predicting the concept of QOL.

The squared multiple correlation (SMC) for the indicators is the proportion of variance in the indicators which is accounted for by the QOL concept and is also the lower bounds for the reliability of the indicators. Thus, each reliability is at least as large as the SMC indicates. The magnitude of the SMC for the indicators suggests that roughly half of the variance of these variables is accounted for by the concept of QOL. For example, the proportion of explained variance in Life 3 is 0.676 and one minus the SMC of the variable is the proportion of error variance (.324) which was obtained from the theta epsilon matrix. The total coefficient of determination is the joint effect of QOL on the observed indicators.

Of the models discussed in this chapter, only the SASS indicator was assigned a fixed theta epsilon to represent a specific proportion of the variance in the indicator as measurement error variance with the remaining variance being left to the corresponding underlying concept. The error variance of SASS was set at 50% of the total variance based on a review of the literature and also because the fit of the model progressively improved up to this value and not beyond it (see Table 4.13).

The measurement error variance of the SASS was originally fixed at 30%. The fit of the model was initially poor but progressively improved as the error variance was raised to 50%. Examining the fit of the model while gradually increasing the error variance demonstrated that the smallest chi square coincided with a measurement error variance of 50% for SASS.

Table 4.13

Model 1: The Chi Square and The Measurement Error of SASS

Assigned Error	Chi Square
30% (but with Life 2 not Life 3)	34.52
42%	11.68
45%	10.05
48%	9.36
50%	9.35
52.5%	9.77
55%	10.62
60%	13.51

Evaluation of Overall Model Fit

The four measures of overall fit of Model 1 to the data are found in page 12 of the output. The chi square value provided in the Lisrel print-out is sensitive to all sources of departure from a good fit; that is, all discrepancies between the sample covariances and those implied by the model. Formally, the chi square test is a test that the observed discrepancies between the sample covariance matrix and the fitted covariance matrix could be due to sampling variation alone. A small chi square signifies a good fit and a large chi-square a bad fit. A large and statistically significant chi square may reflect model misspecification.

The Lisrel output for Model 1 indicates that the fit between the sample covariances and the model-implied covariances is adequate. The chi square with 6 degrees of freedom is 9.35 with probability 0.155 (see Table 4.12). Since the probability of 0.155 does not exceed the traditional 0.05 criteria, one must accept (fail to reject) that the differences between the model-implied covariance matrix and the observed covariances are small enough to be sampling fluctuations. This value falls within a region that would be expected by chance 95% of the time and the conclusion is that if sigma (model-implied covariance matrix) was the population covariance matrix, then it is possible that the sample covariance matrix could have been observed. However, Hayduk (1987) warns that adopting the usual 0.05 level of significance amounts to accepting models as adequate if the observed sampling fluctuations could appear in about 1 in every 20 samples. The predicted sigma matrix for this model is sufficiently close to the observed data matrix for the remaining differences to be mere sampling fluctuations. That is, Model 1 is not significantly worse than a perfect model capable of predicting a sigma (model-implied covariances) that is identical to the observed data.

Researchers also use a goodness of fit index (GFI), an adjusted goodness of fit index (AGFI), and the root mean squared residuals to assess the fit of a structural equation model to the sample data covariance matrix. The GFI depends on a comparison between the observed covariances and the residuals. The AGFI adjusts for the degrees of freedom of a model relative to the number of variables. Both indices reach their maximum of one when there is a perfect match between the model predicted covariance matrix and the sample covariance matrix. For the model in Figure 4.3 the GFI is 0.988. The AGFI is very acceptable at a value of 0.980. The root mean squared residual is the square root of the mean of the squared residuals and for Model 1 the root mean square residual is 0.033. However, this measure is most interpretable when all observed indicators are standardized; it is useful for comparing the fit of different models to the same data.

Even though this measurement model of QOL fits the sample data, it does not mean that it is the correct or even the best model. It does indicate that a model has been located with a set of coefficient estimates that has survived a statistical and substantive challenge that results in the failure of many models. It cannot be proved that Model 1 is a valid model of the measurement of QOL for CABG surgical patients but at this time and in this context, the model cannot be rejected. The construct-related validity evidence of the measurement of QOL will be strengthened by future cross-validations of the fit of this model on different samples.

Detailed Assessment of Model Fit

To assess the fit of Model 1 in more detail one examines the modification indices, the standard errors and T-values, the fitted residuals and the standardized residuals. These are used to determine sources of model misspecification and ways in which the model fit might be improved. First, the modifications indices, found on page 13 of the LISREL output, focus attention on the fixed parameters of the model. The modification index for a given fixed parameter is a measure of the predicted decrease in the chi square if the model was re-estimated with that parameter free instead of fixed. The largest modification index in Model 1 is for the correlation between the measurement errors of the Faces scale and the SASS (5.75), indicating that relaxing this parameter should lead to a decrease in the minimum of the fitting function and hence, a substantial improvement in the fit of the model. However, this parameter was not freed because there was no theoretical justification for doing so.

The standard errors and the T-values are reported on page 14 and page 15, respectively, of the LISREL output. The standard errors, which are not scale invariant, are measures of the precision of the parameter estimate. The T-value for a parameter is defined as the parameter estimate divided by its standard error. This can be used to test the hypothesis that the true parameter value is zero. Parameters whose T-values are larger than two in magnitude are normally judged to be statistically different from zero. The T-values for the estimated coefficients in Model 1 are all large, and thus, all the estimated parameters are highly significant.

The correlations among the estimates are found on page 16 of the computer printout. Extremely large correlations indicate that the estimates of the two-parameter estimators are very closely associated. High correlations may indicate collinearity problems. Scanning the matrix of correlation among the estimates do not suggest collinearity problems.

The next set of output (pages 17 and 18) focuses on the fitted residuals and the standardized residuals. The residuals, the discrepancies between the observed covariances and the model implied covariances, can be found on page 17 of the computer output. The output labeled fitted moments is the sigma matrix or the covariances implied by the estimated coefficients of Model 1. Maximum likelihood estimation of the nine coefficients in the model minimized the residuals. A model has implications for the variances/covariances of the observed indicators and these implied covariances should be as close to the data covariances as possible. The residuals focus on aspects of the model that provide the connections between observed variables, one pair at a time. The residuals can be helpful in locating variables between which the largest problems exist but they cannot indicate which corrections should be introduced.

In general, a fitted residual is the difference between an observed covariance and the corresponding model-implied covariance. The size of these residuals must always be judged relative to the size of the elements of the data matrix. The fitted residuals depend on the metric of the observed variables and are, therefore, difficult to use in the assessment of fit. In Model 1 the largest residual is for the covariance between the Faces scale and the SASS (0.099) and this residual is of little concern. These two variables may share some source of covariation that is not included in the current model (e.g., a common cause).

The residuals become more scrutinizable if they are expressed in a common metric. LISREL does this by dividing each covariance by an estimate of that covariance's asymptotic standard deviation. The standardized residuals are reported just after the unstandardized residuals in the output. If the standardized residual is larger than 2.58 in magnitude this indicates that the model does not account for the data sufficiently well (Joreskog & Sorbom, 1988, p. 92). The standardized residuals help identify the aspects of the data that are inconsistent with the current model estimates.

There is no such evidence for any major lack of fit in Model 1. The largest standardized residual is 0.945 corresponding to the covariance between the Faces Scale and the SASS. If the residuals are truly random, they should be approximately normally distributed. A plot of the standardized residuals can be found on page 18 of the computer output and the near linearity of this plot provides assurance of the near-normality of the residuals in Model 1.

For the interpretation of Model 1, page 19 of the computer output is not useful since there are no indirect effects in this model. The model-implied covariances between the QOL concept and the indicators, one at a time, can be found on page 20 of the computer output. The first order derivatives are found on page 21 of the computer output. These values are a technical component of how one obtains a maximum likelihood estimate, and a rescaled and more useful version of these are the modification indices which have already been discussed.

Page 22 of the printed output provides the factor scores regressions given by the program. Though difficult to interpret, these coefficients represent the estimated multivariate regression of QOL on all the observed variables. Finally, the standardized solution for this model is found on page 23 of the computer print out. That is, the concept has been standardized to have a mean of 0 and a variance of 1. The indicators are not standardized and retain their real metric variances. Thus, while the lambda values will change, they are not standardized because they connect one standardized variable (the QOL concept) to an unstandardized variable (an indicator).

The driving force behind the construction and analysis of Model 1 was the concern with the measurement properties -

validities and reliabilities - of the instruments used to measure the unobserved concept QOL. QOL is conceptualized as a common cause of 5 indicators or traditional measures of the concept. The value of the chi square suggests that Model 1 is able to account for the variances and covariances of the sample data, though it is not able to perfectly reproduce the sample data covariances. However, in this model there is no evidence of unreasonable estimates as indicators of poor fit such as negative variances, correlations larger than one, SMCs below zero or exceedingly large standard errors.

The estimated effects of QOL (lambda coefficients) on the indicators can be interpreted as slope coefficients of regression analysis. For each unit increase in QOL, the predicted value of Life 3 increases by 0.523 units. Similarly, for each unit increase in QOL, the predicted value of MDT1, the Faces Scale, and SWB11 increase by 0.492, 0.540, and 0.583 units, respectively. The effect between QOL and the SASS indicator is fixed at 1.0 to scale the units of QOL to match the units of the SASS. This provides QOL with a specific variance that is about 50% of the variance in the SASS.

The fact that the effect of QOL on the Life 3 Scale is less than 1.0 does not mean that QOL is a weaker cause of Life 3 than of the SASS. On the contrary, QOL is a stronger predictor of Life 3 than the SASS since QOL accounts for only 50% of the variance in the SASS and 67.6% of the variance in

Life 3. The fact that the predicted effect of QOL on Life 3 (0.523) is smaller than the value of 1.0 for the SASS is driven by both the effectiveness of QOL in predicting Life 3 and the metric scales on which both the SASS and Life 3 are measured.

The evaluation of Model 1 suggests that only about 50% of the variance in any of the five measures of QOL is actually arising from a concept that is a common source of all the five measures. According to this model the remaining variance in any one of the five measures is provided by sources unique to each instrument so that one might claim that about 50% of the variance in each indictor arise from sources completely divorced from the other indicators.

Model 1 is a formal representation of an underlying theory proposed as a result of the investigator's causal thinking about how QOL influences multiple indicators of QOL. This theory approximates the truth about the nature of QOL to an unknown degree and the model which represents this theory can do no better. Model building and modification is a process of successive approximations to a truth that can never be grasped in its entirety. Although Model 1 may only be an approximation of an unknown reality, precisely because the truth can never be known for sure, the structural equations set out in the model are useful for organizing and evaluating the causal thinking about QOL. The consistencies, or lack of, between the structural equations of some different models of QOL and causal thinking will be examined in the remaining pages of this chapter.

Model 2: The Components of Life 3

While the adequacy of measurement Model 1 is not in dispute, a second model was created to delineate the method by which Life 3 was derived (see Figure 4.4). Remembering that Life 3 is the mean value of two administrations of the same instrument, represented as Life 1 and Life 2, the Life 3 indicator in the first model has been replaced, in this second model, with the two components from which it was derived. All other aspects of Model 2 are identical to the first model.

Fewer iterations were required to converge to a solution for Model 2 compared to Model 1. The maximum likelihood estimates for Model 2 are provided in Table 4.14. In general, the loadings of the indicators on the QOL concept are quite similar to those of Model 1. The lambda coefficient for the indicator Life 2 in Model 2 is even larger (0.582) than for the indicator Life 3 (0.523) of Model 1. The lambda estimate for Life 1 is the lowest of all the lambda estimates of Model 2 at 0.483.

Figure 4.4 Model 2: Measurement of Quality of Life
Maximum Likelihood Estimates

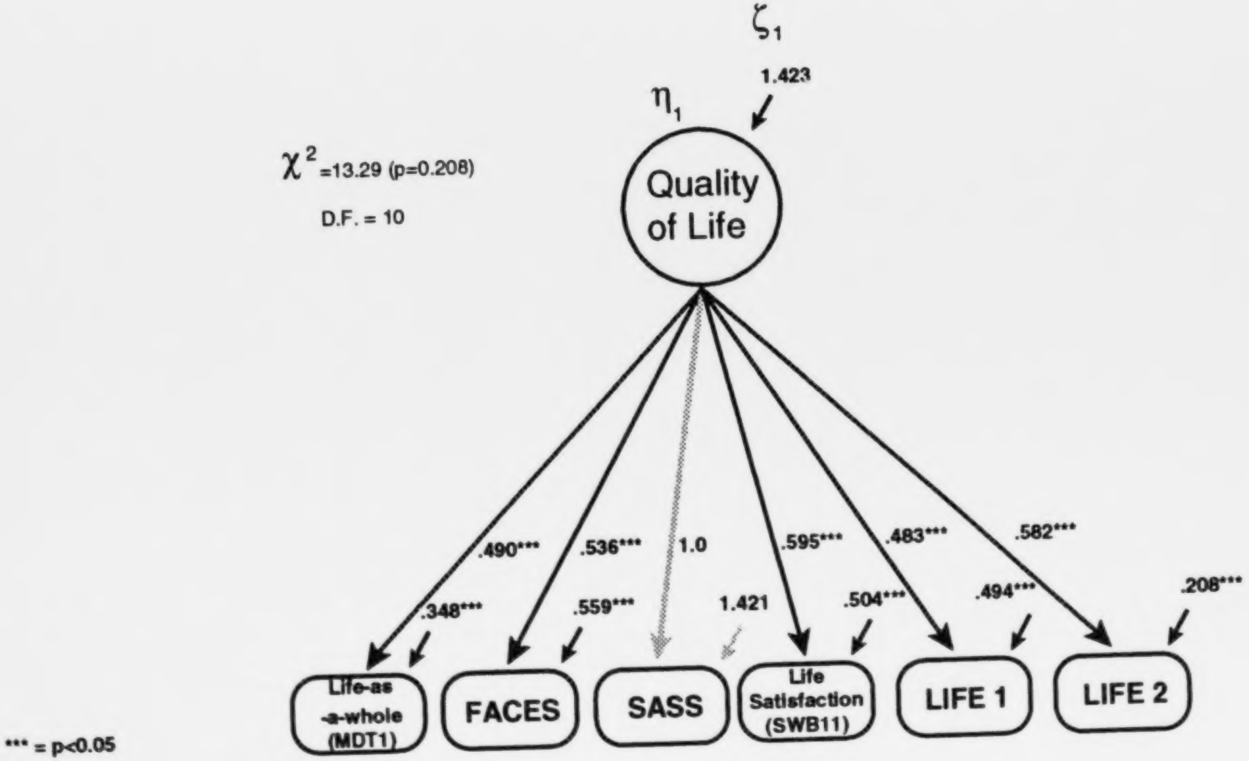

ζ_1
1.423
η_1
Quality of Life
χ^2 =13.29 (p=0.208)
D.F. = 10
.490***
.536***
1.0
.595***
.483***
.582***
.348***
.559***
1.421
.504***
.494***
.208***
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 1
LIFE 2
*** = p<0.05

Table 4.14

Maximum Likelihood Estimates For Two Models of QOL

	Model 1	**Model 2**
Df	6	10
Chi Square	9.35	13.29
p	0.155	0.208
Squared Multiple Correlations of The Indicators		
MDT1	0.505	0.495
FACES	0.434	0.422
SASS	0.500*	0.500*
SWB11	0.485	0.500
Life 1	na	0.402
Life 2	na	0.698
Life 3	0.676	na
Lambda Coefficients		
MDT1	0.492	0.490
FACES	0.540	0.536
SASS	1.00*	1.00*
SWB11	0.587	0.595
Life 1	na	0.483
Life 2	na	0.582
Life 3	0.523	na
Measurement Error Variance		
MDT1	0.341	0.348
FACES	0.547	0.559
SASS	1.421*	1.421*
SWB11	0.519	0.504
Life 1	na	0.494
Life 2	na	0.208
Life 3	0.189	na

* = fixed coefficients

The total unexplained error variance of the QOL concept is slightly reduced in Model 2 compared to Model 1. In general, the theta epsilons for the indicators are slightly increased in Model 2 compared to Model 1. However, the estimated measurement error variance is slightly reduced for the SWB11 indicator. In Model 2, Life 1 has twice the measurement error variance of Life 2 and both possess more measurement error variance than Life 3 of Model 1. The estimated error variance of Life 3 in Model 1 is 0.189. The error variance of Life 1 and Life 2 of Model 2 are 0.494 and 0.208, respectively. The SMC for the indicators are generally slightly worse in Model 2 as compared to Model 1. However, the SMC for Life 3 in Model 1 was 0.676; in Model 2, the SMC for Life 1 is 0.402 and for Life 2 is 0.698. Therefore, many of the QOL measures are slightly more distant from the SASS indicator (QOL scale) than in the previous model.

The attempt to model the components of Life 3 is roughly as successful as Model 1 if one examines the chi square of Model 2. With 10 degrees of freedom, compared to the 6 degrees of freedom in Model 1, the chi square for Model 2 is 13.29 ($p=0.208$). Since there are more degrees of freedom for Model 2 it indicates that the model has come close to duplicating the observed covariance matrix slightly more parsimoniously than Model 1. Hayduk (1987) suggests designing models with many degrees of freedom since the more degrees of freedom a model has the more parsimonious is the prediction of an acceptably fitting model-implied covariance matrix.

Model 3: A Model of The Data Collection Process

Model 3 was created to better mirror the data collection process (see Figure 4.5). This model includes all three indicators, Life 1, Life 2, and Life 3 as well as the Faces Scale, MDT1, SWB11, and the SASS. This data matrix is, therefore, larger than those analyzed in the previous models. The lower right portion of the model of Figure 4.5 acknowledges that Life 3 is a derived mean value of Life 1 and Life 2. The equation for the concept Life 1 is:

$$\underset{\text{(concept)}}{\text{Life 1}} = (1.0)\ \underset{\text{(indicator)}}{\text{Life 1}} + (0.5)\ \underset{\text{(indicator)}}{\text{Life 3}} + \text{error}$$

In words, the concept Life 1 is scaled to the Life 1 indicator with a value of 1.0 and also causally influences the indicator Life 3 by a value of 0.5. The error in the equation reflects the unexplained error in accounting for the concept. The equation for the indicator Life 1 is:

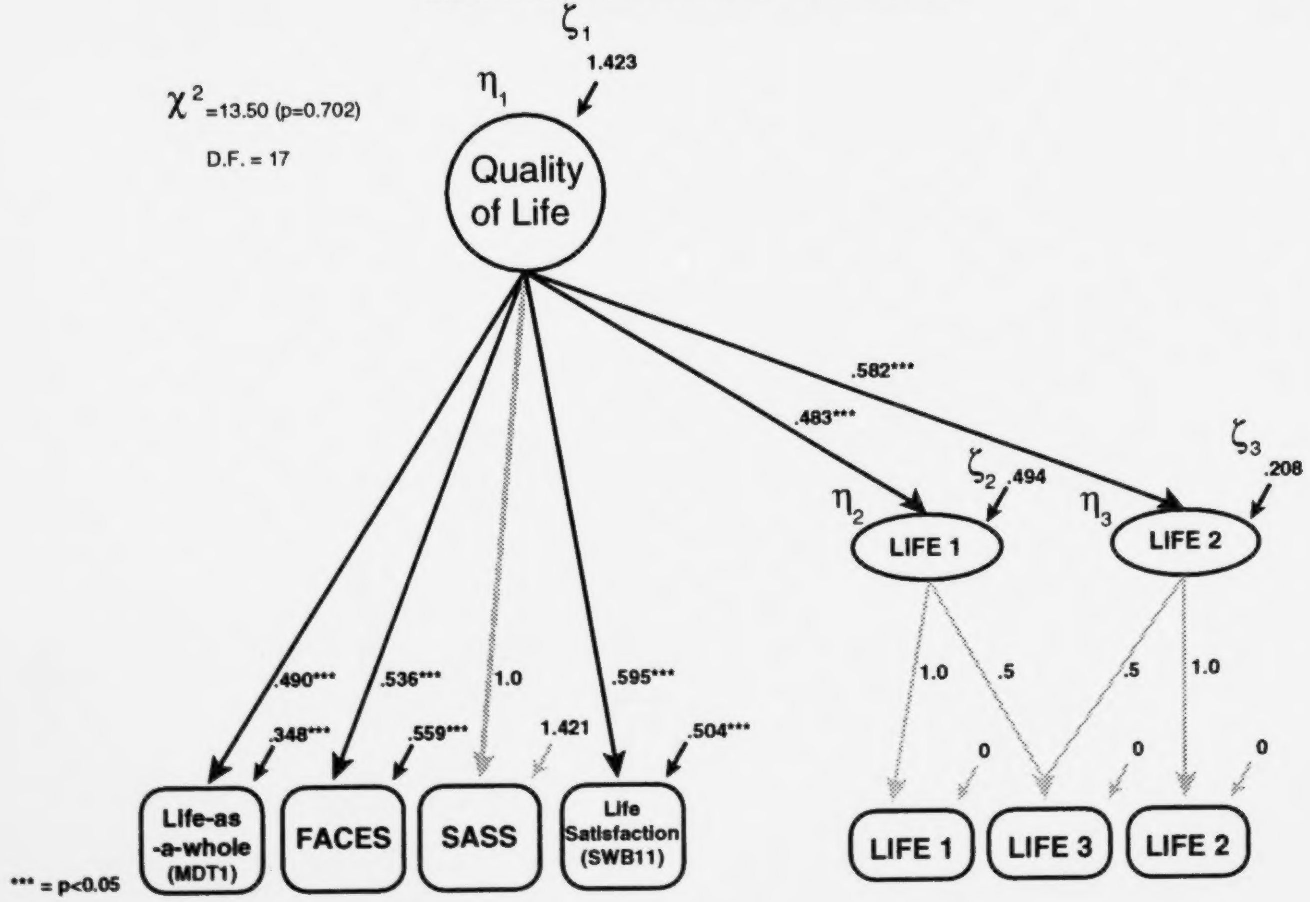
$$\underset{\text{(Indicator)}}{\text{Life 1}} = (1.0)\ \underset{\text{(concept)}}{\text{Life 1}} + 0$$

where Life 1, to the left of the equation, is the indicator of the concept Life 1 on the right side of the equation. The measurement error is fixed at zero. Similarly, the equation for the concept Life 2 is:

$$\underset{\text{(concept)}}{\text{Life 2}} = (1.0)\ \underset{\text{(indicator)}}{\text{Life 2}} + (0.5)\ \underset{\text{(indicator)}}{\text{Life 3}} + \text{error}$$

where the Life 2 concept is scaled to the Life 2 indicator with a value of 1.0 and also influences the Life 3 indicator with a value of 0.5. The error is the error in predicting the Life 2 concept by the variables in the equation. The equation

Figure 4.5 Model 3: Measurement of Quality of Life
Maximum Likelihood Estimates


χ^2 =13.50 (p=0.702)
D.F. = 17
ζ_1
1.423
η_1
Quality of Life
.490***
.536***
1.0
.595***
.348***
.559***
1.421
.504***
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
*** = p<0.05
.582***
.483***
ζ_2 .494
η_2
LIFE 1
ζ_3 .208
η_3
LIFE 2
1.0
.5
.5
1.0
0
0
0
LIFE 1
LIFE 3
LIFE 2

for the indicator Life 2 is:

$$\underset{\text{(indicator)}}{\text{Life 2}} = (1.0)\ \underset{\text{(concept)}}{\text{Life 2}} + 0$$

and has the same interpretation as for the indicator Life 1. Finally, the equation for the Life 3 indicator is:

$$\underset{\text{(Indicator)}}{\text{Life 3}} = (0.5)\ \underset{\text{(concept)}}{\text{Life 1}} + (0.5)\ \underset{\text{(concept)}}{\text{Life 2}} + 0$$

That is, Life 3 is forced to be half of Life 1 and half of Life 2. The indicators Life 1, Life 2, and Life 3 are assigned a measurement error of zero because they are totally and completely explained by the concepts from which they arise. In addition, beta coefficients to be estimated are added to express a relationship between these two concepts, Life 1 and Life 2, and QOL.

The value of the measurement error variance (theta epsilon) of the indicator Life 1 in Model 2 now is the error (psi) in predicting the concept Life 1 in Model 3 (See Table 4.15). Similarly, the measurement error variance of the indicator Life 2 in Model 2 is now the error in predicting the Life 2 concept in Model 3. The psi error variance of the concepts Life 1 and Life 2 is appropriately interpreted as measurement error variance because the conceptual variables Life 1 and Life 2 have been created such that Life 3 is expressed in terms of its component parts.

Table 4.15

Maximum Likelihood Estimates Of The Models of QOL

	Model 1	**Model 2**	**Model 3**
Df	6	10	17
Chi Square	9.35	13.29	13.50
p	0.155	0.208	0.702
Squared Multiple Correlations of The Indicators			
MDT1	0.505	0.495	0.495
Faces	0.434	0.422	0.422
SASS	0.500*	0.500*	0.500*
SWB11	0.485	0.500	0.500
Life 1	na	0.402	1.00*
Life 2	na	0.698	1.00*
Life 3	0.676	na	1.00*
Lambda Coefficients			
MDT1	0.492	0.490	0.490
Faces	0.540	0.536	0.536
SASS	1.00*	1.00*	1.00*
SWB11	0.587	0.595	0.595
Life 1	na	0.483	1.0*
Life 2	na	0.582	1.0*
Life 3	0.523	na	0.5+0.5*
Measurement Error Variance			
MDT1	0.341	0.348	0.348
Faces	0.547	0.559	0.559
SASS	1.421*	1.421*	1.421*
SWB11	0.519	0.504	0.504
Life 1	na	0.494	0.00*[1]
Life 2	na	0.208	0.00*
Life 3	0.189	na	0.00*
Squared Multiple Correlations For Structural Equations			
QOL	0.00	0.00	0.00
Life 1	na	na	0.402
Life 2	na	na	0.698

* = fixed coefficients

1 = For some unknown technical reason, it was necessary to assign a value of 0.0001 rather than a value of 0.0000 for the error variance of the indicator Life 1 to gain convergence of a maximum likelihood solution.

The maximum likelihood estimates for Model 3 are largely identical to those of Model 2. The effect of the QOL concept on the concept Life 2 (0.582) is larger than the effect on the concept Life 1 (0.483). The beta coefficient estimates of Model 3 are exactly the values of the lambda coefficient estimates of the Life 1 and Life 2 indicators of Model 2.

The overall fit of Model 3 is as acceptable as the previous two. The chi square with 17 degrees of freedom is 13.50 (p=0.702). As in the previous models, the largest modification index in Model 3 is 6.93 for the theta epsilon between the Faces scale and the SASS. All estimated coefficients for Model 3 are highly significant as indicated by the T-values. Therefore, the conclusion is that Model 3 is just as adequate as the previous two models. The strength of Model 3 is that it is driven by partial correspondence to the operational procedures of the derivation of the data. While it is the same conceptual model as the previous two, Model 3 adds a consistency with the methodology of the study.

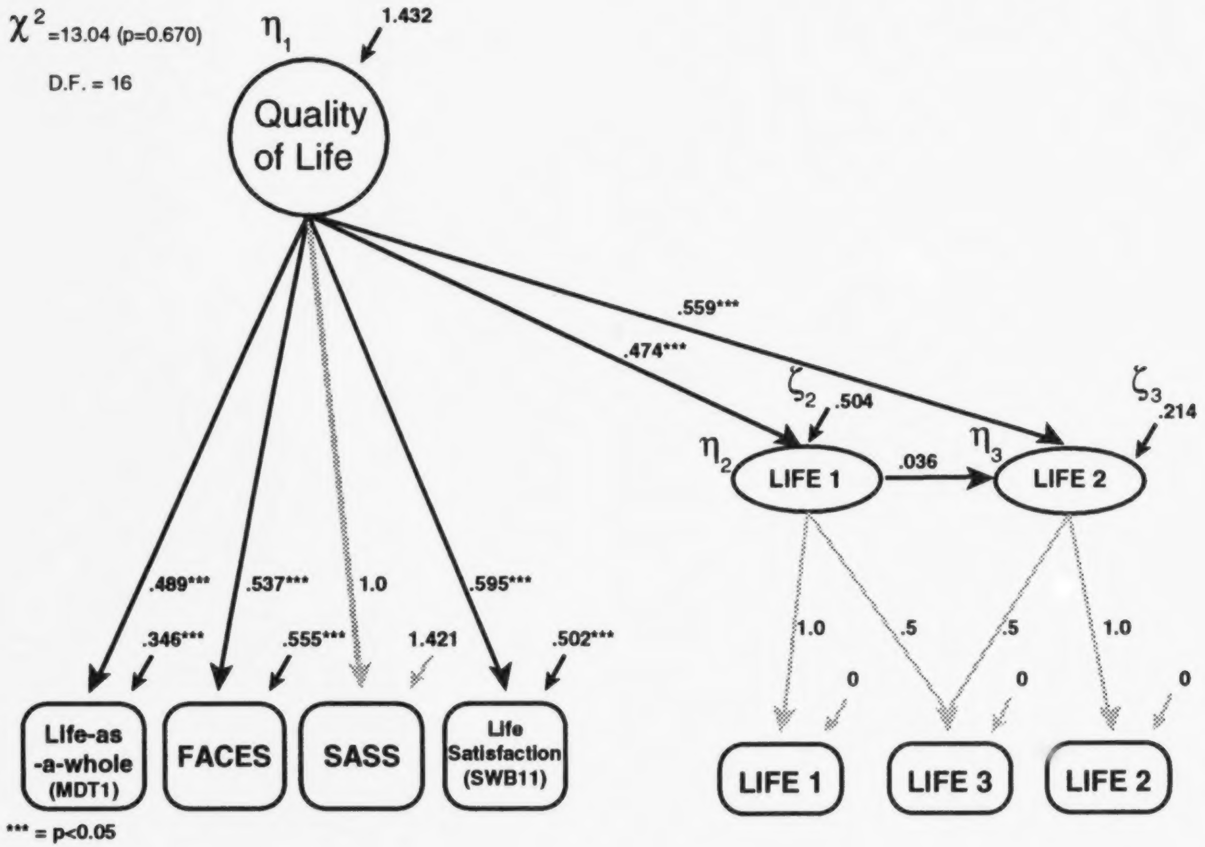
Model 4: The Effect of Life 1 on Life 2

The previous models lay the foundation for a discussion of a model which examinations whether the scores on the Life 2 indicator could be influenced by the scores on an earlier administration of the same instrument, namely, Life 1. In turn, the concept Life 1 could plausibly influence the concept Life 2. Thus, a coefficient to be estimated, representing the effect of the concept Life 1 on Life 2 was inserted (see Figure 4.6). All other aspects of Model 4 are identical to Model 3.

Most of the maximum likelihood estimates and diagnostics are similar to the previous models. With 16 degrees of freedom, the chi square for Model 4 is 13.04 (p=0.670). The additional estimated coefficient between the concepts Life 1 and Life 2 exhibits a very weak and statistically insignificant effect. This supports the observation noted earlier that CABG patients failed to notice that they were asked to respond to the same instrument twice during the interview. The beta coefficients between QOL and the concepts Life 1 and Life 2 are minimally reduced compared to Model 3 (see Table 4.16).

Therefore, while the model as a whole is adequate, the hypothesis that memory of an earlier response to Life 1 (or some other intervening construct) influences the responses on Life 2 cannot be accepted. It appears that when the CABG patients respond to the Life 3 Scale a second time, they are cognitively recalculating the evaluation of their lives by re-accessing the concept QOL. Fox and Kahneman (1992) suggest that responses to life satisfaction questions are both outcomes of a cognitive process which involves interpretation, memory search, evaluation, and editing, and a result of opportunistic reliance on cues provided by the questions itself, by earlier questions in the survey, and by the circumstances of the moment.

Figure 4.6 Model 4: Measurement of Quality of Life
Maximum Likelihood Estimates


χ^2 =13.04 (p=0.670)
D.F. = 16
η_1
1.432
Quality of Life
.559***
.474***
ζ_2 .504
ζ_3 .214
η_2
LIFE 1
.036
η_3
LIFE 2
.489***
.537***
1.0
.595***
.346***
.555***
1.421
.502***
1.0
.5
.5
1.0
0
0
0
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 1
LIFE 3
LIFE 2
*** = p<0.05

The lack of evidence for a hypothesized memory or retest effect between the two responses on the Life 3 scale is extremely important. While recognizing that memory was not explicitly measured in this study, the speculation of no memory effect could not have been tested in a factor analytic model. Using LISREL modeling, it was possible to demonstrate that the respondents' scores on the second administrations of the Life 3 Scale were not influenced by their response to the first administration of the instrument. They had to reassess their QOL which connects to all the other indicators they responded to.

Table 4.16

Maximum Likelihood Estimates Of The Models of QOL

	Models			
	1	2	3	4
Df	6	10	17	16
Chi Square	9.35	13.29	13.50	13.04
p	0.155	0.208	0.702	0.670
Squared Multiple Correlations of The Indicators				
MDT1	0.505	0.495	0.495	0.497
Faces	0.434	0.422	0.422	0.426
SASS	0.500*	0.500*	0.500*	0.500*
SWB11	0.485	0.500	0.500	0.502
Life 1	na	0.402	1.00*	1.00*
Life 2	na	0.698	1.00*	1.00*
Life 3	0.676	na	1.00*	1.00*
Lambda Coefficients				
MDT1	0.492	0.490	0.490	0.489
Faces	0.540	0.536	0.536	0.537
SASS	1.00*	1.00*	1.00*	1.00*
SWB11	0.587	0.595	0.595	0.595
Life 1	na	0.483	1.00*	1.00*
Life 2	na	0.582	1.00*	1.00*
Life 3	0.523	na	.5+.5*	.5+.5*
Measurement Error Variance				
MDT1	0.341	0.348	0.348	0.346
Faces	0.547	0.559	0.559	0.555
SASS	1.421*	1.421*	1.421*	1.421*
SWB11	0.519	0.504	0.504	0.502
Life 1	na	0.494	0.00*	0.00*
Life 2	na	0.208	0.00*	0.00*
Life 3	0.189	na	0.00*	0.00*
Squared Multiple Correlations For Structural Equations				
QOL	0.00	0.00	0.00	0.00
Life 1	na	na	0.402	0.389
Life 2	na	na	0.698	0.689

* = fixed coefficients

Model 5: The Final Model

The final revision of the measurement model of QOL involves adding a coefficient to be estimated between the measurement errors of the Faces Scale and the SASS (see Figure 4.7). The revision is justified because this was the largest modification index in all of the prior models. With 15 degrees of freedom, this final model is very acceptable with a chi square of 6.66 ($p=0.966$) (see Table 4.17).

Compared to Model 4, this final model reveals slight differences. First the estimated lambda coefficients are increased for the MDT1 and SWB11 items but decreased for the Faces Scale. Second, the effect between QOL and both the concepts Life 1 and Life 2 are larger than in the previous model. However, the effect of the concept Life 1 on the concept Life 2 is even smaller and less significant than in Model 4. The errors in predicting the concepts in the final model are all reduced compared to Model 4. Also, the theta epsilon estimate is increased for the Faces scale but decreased for SWB11. The added estimate of the covariance between the measurement errors for the Faces Scale and the SASS is 0.149, a value which is just statistically significant and which implies a correlation of 0.163 $[.149/(.586 \times 1.421)]^{1/2} = 0.149 /.912 = 0.163)$. There may be a common source of variance between these two measures in addition to the concept QOL.

Figure 4.7 Model 5: Measurement of Quality of Life
Maximum Likelihood Estimates

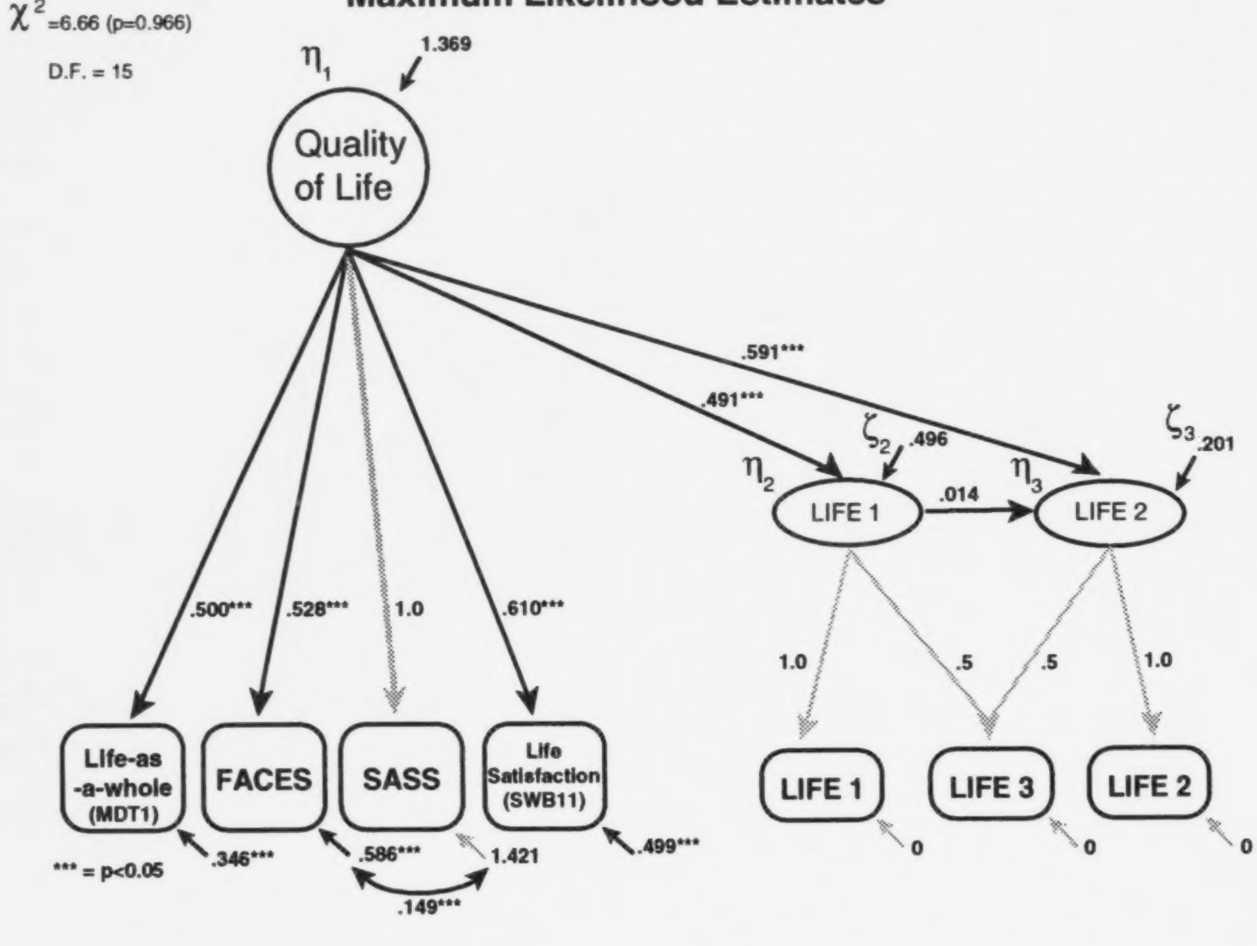

χ^2 =6.66 (p=0.966)
D.F. = 15
η_1
1.369
Quality of Life
.500***
.528***
1.0
.610***
.591***
.491***
η_2
ζ_2
.496
LIFE 1
.014
η_3
ζ_3
.201
LIFE 2
1.0
.5
.5
1.0
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 1
LIFE 3
LIFE 2
.346***
.586***
1.421
.499***
.149***
0
0
0
*** = p<0.05

Table 4.17

Maximum Likelihood Estimates Of The Models of QOL

	Models				
	1	2	3	4	5
Df	6	10	17	16	15
Chi Square	9.35	13.29	13.50	13.04	6.66
p	0.155	0.208	0.702	0.670	0.966
Squared Multiple Correlations of The Indicators					
MDT1	0.505	0.495	0.495	0.497	0.497
Faces	0.434	0.422	0.422	0.426	0.395
SASS	0.500*	0.500*	0.500*	0.500*	0.500*
SWB11	0.485	0.500	0.500	0.502	0.505
Life 1	na	0.402	1.00*	1.00*	1.00*
Life 2	na	0.698	1.00*	1.00*	1.00*
Life 3	0.676	na	1.00*	1.00*	1.00*
Lambda Coefficients					
MDT1	0.492	0.490	0.490	0.489	0.500
Faces	0.540	0.536	0.536	0.537	0.528
SASS	1.00*	1.00*	1.00*	1.00*	1.00*
SWB11	0.587	0.595	0.595	0.595	0.610
Life 1	na	0.483	1.0*	1.00*	1.00*
Life 2	na	0.582	1.0*	1.00*	1.00*
Life 3	0.523	na	.5+.5*	.5+.5*	.5+.5*
Measurement Error Variance					
MDT1	0.341	0.348	0.348	0.346	0.346
Faces	0.547	0.559	0.559	0.555	0.586
SASS	1.421*	1.421*	1.421*	1.421*	1.421*
SWB11	0.519	0.504	0.504	0.502	0.499
Life 1	na	0.494	0.00*	0.00*	0.00*
Life 2	na	0.208	0.00*	0.00*	0.00*
Life 3	0.189	na	0.00*	0.00*	0.00*
Squared Multiple Correlations For Structural Equations					
QOL	0.00	0.00	0.00	0.00	0.00
Life 1	na	na	0.402	0.389	0.400
Life 2	na	na	0.698	0.689	0.709

* = fixed coefficients

Attempts To Scale QOL With Different Indicators

The purpose of this chapter is to explore the construct-related validity of the measurement model of QOL. To extend this analysis, an attempt was made to operationalize the concept QOL with the multiple indicators other than the SASS. Using measurement Model 3, illustrated in Figure 4.5, the Faces Scale, the MDT1 item, and the SWB11 item were each used as the scaling indicator for QOL.

Bollen (1989) argues that the validity of a measure of a concept is the magnitude of the lambda coefficient linking that measure to the concept. A fundamental issue of validity involves the question of whether a causal relation exists between the concept and an observed variable. It had already been demonstrated that the lambda coefficients connecting QOL to all five indicators of the previous five measurement models are statistically significant. The question now explored concerns the fit of the model to the data when QOL is assigned a measurement scale other than the SASS.

To answer this question, the lambda coefficient linking the Faces Scale to QOL was set to 1.0. This set the scale for QOL to that of the Faces Scale. The other lambdas leading from QOL to the SASS, MDT1, and SWB11 indicators are now free to be estimated. Moreover, the measurement error variance of the Faces Scale is fixed at 50% of the total variance of that indicator. With 17 degrees of freedom the chi square is 16.02 (p=.523) compared to a chi square of 6.66

(p=0.966) when the SASS was chosen as the measurement scale for the QOL concept. All of the estimated coefficients are statistically significant.

The measurement error variance for the Faces Scale was first increased to 55% and then to 60%. The chi square for this model improved to 13.78 (p=0.682), and then at 60% error, it improved further to 13.66 (p=0.691). It was not possible to obtain a better fitting model with this indicator as the scale for the QOL concept. Therefore, the Faces Scale is less acceptable than the SASS as an indicator of QOL because the error variance of the Faces Scale had to be increased to 60% (compared to 50% for the SASS indicator) to obtain an adequately fitting measurement model of QOL.

When the MDT1 item and the SWB11 item, each with a fixed measurement error variance of 50%, were, in turn, used to scale the QOL concept, the model chi square with 17 degrees of freedom was adequate at 13.51 (p=0.702) and 13.50 (p=0.702), respectively. Using SWB11 to scale the QOL concept, a beta coefficient to be estimated was inserted between the concepts Life 1 and Life 2. With 16 degrees of freedom, the chi square improved slightly to 13.03 (p=0.671). The effect of the concept Life 1 on Life 2 was not statistically significant as was discovered in Model 4.

While all of the indicators used to measure QOL in this chapter were adequate for scaling the concept, the SASS indicator provided the best overall fit of the model.

Consistent with the findings of previous research, all the indicators contained a considerable amount of measurement error.

Summary

The clinical and demographic characteristics of the sample are presented in this chapter. Next, the descriptive statistics for the measures of QOL are examined. The internal consistency reliability of the only composite measure, the Index of Well-Being (IWB), was relatively high (maximum alpha of 0.90). The correlation among the measures of QOL ranged from 0.43 to 0.94. The highest correlation was between the IWB and the Life Satisfaction item of the same instrument.

Five models representing the measurement of perceived QOL were proposed and tested. All of the models fit the data adequately even if the latter models more precisely delineate the process of how the instruments were administered. The best overall fit was achieved with last model. This model delineates the affect of QOL on four indicators: MDT1, the Faces Scale, the SASS, and SWB11. Also depicted in the model is the effect of QOL on two concepts, Life 1 and Life 2, each measured with indicators by the same name as the concept it represents. Further, the model shows the mechanism of how the Life 3 Scale is derived - as the mean value of Life 1 and Life 2, the two administrations of the instrument. The effect of the concept Life 1 on Life 2 was not significant.

The absence of evidence of a memory or retest effect is most notable because this lack of consistency suggests a re-tapping or re-assessing of QOL each time an evaluation is requested. This is probably not a superficial re-assessment but rather a deep, subjective re-evaluation that is a fundamental entity of all the five indicators considered in this measurement model.

This model is a representation of causal thinking about the measurement of QOL but this is not to suggest that it represents the true measurement of perceived QOL - one cannot confirm causation in the real world with any certainty. It does suggest that the measurement model is plausible and it stands on its own merit until it is rejected in further research. Subsequent chapters will lend support for the construct-related validity of this measurement model of QOL when the predictors of QOL are considered.

Unfortunately, there is significant measurement error (about 50%) in all of the items used as indicators of QOL. Creating parallel multi-item measurement tools (as measurement theory would suggest) is one potential solution to the problem of measurement error. The other solution might involve writing clearer and more precise stems for the single item indicators. The conceptualization of QOL as a global evaluation of one's life is a line of research that ought to continue until it is consistently supported or disproved in cross-validation studies.

V. THE RELATIONSHIP BETWEEN HEALTH AND QUALITY OF LIFE

This chapter describes the analyses of the relationship between perceived health and quality of life (QOL). The discussion surrounds three major types of analyses: (1) descriptive statistics (2) factor analysis of the SF-36 Health Survey, a measure of perceived health, and (3) structural equation modeling of the relationship between the constructs of perceived health and perceived QOL.

The SF-36 Health Survey is a multi-item scale measurement of eight concepts: (1) physical functioning (PF), (2) role limitations due to physical health problems (RP), (3) bodily pain (BP), (4) general health perceptions (GH), (5) vitality (VT), (6) social functioning (SF), (7) role limitations due to emotional problems (RE), and (8) mental health (MH). The acute version of the SF-36 was used in the present study because the health assessments were made at a rapidly changing time in the participants' recovery from CABG surgery. This version uses a "1-week" recall period rather than the "4-week" recall period used in the standard version. Therefore, the acute version was decidedly more appropriate given the greater sensitivity to changes in health status within a short period of time. The procedure for recoding the items, grouping the items into subscales and transforming each subscale to a 0 to 100 scale was followed as outlined in the manual (Ware, 1993).

Raw and transformed scale scores are not calculated for the second item of the questionnaire -- the Reported Health Transition item. As suggested by Ware (1993), the responses to this item are treated as ordinal level data and the percentage of respondents who select each response choice is calculated.

Descriptive Statistics

The descriptive data for the eight SF-36 Health Survey subscales are provided in Table 5.1. The subscales are ordered, as suggested in the SF-36 Health Survey Manual and Interpretation Guide, from the subscale thought to be the most valid measure of the physical component of health status, Physical Functioning, to the last subscale in the table, Mental Health, which is proposed as the most valid measure of the mental component of health status.

Five subscales (Physical Functioning, Role Functioning-Physical, Bodily Pain, Social Functioning, and Role Functioning-Emotional) define health status as the absence of limitation or disability. For these subscales, the highest possible score of 100 is achieved when no limitations or disabilities are observed. The three remaining subscales (General Health Perceptions, Vitality, and Mental Health) are "bipolar" in nature and measure a much wider range of negative and positive health states. For these subscales, a score in the mid-range is earned when respondents report no limitations or disability. A score of 100 on these bipolar

Table 5.1

Descriptive Statistics of Score Distributions for SF-36 Health Survey Subscales

Scale	PF	RP	BP	GH	VT	SF	RE	MH
Items	10	4	2	5	4	2	3	5
Mean	64.05	37.42	63.74	70.48	57.06	77.16	70.70	76.71
Median	65.00	25.00	62.00	72.00	55.00	75.00	100.00	80.00
Mode	70.00	0.00	100.00	82.00	50.00	100.00	100.00	92.00
Range	85.00	100.00	88.00	88.00	100.00	87.50	100.00	88.00
Standard Deviation	18.69	36.68	21.98	16.51	19.30	22.34	37.82	17.32
Variance	349.26	1345.28	483.01	272.59	372.63	498.88	1430.35	299.88
Skewness	-.55	-.51	-.06	-.87	-.33	-.75	-.82	-1.06
Standard Error (SE)	1.07	2.10	1.26	0.94	1.104	1.28	2.16	0.99

n=306

PF = Physical Functioning Subscale
RP = Role-Physical Subscale
BP = Bodily Pain Subscale
GH = General Health Perceptions Subscale
VT = Vitality Subscale
SF = Social Functioning Subscale
RE = Role-Emotional Subscale
MH = Mental Health Subscale

subscales is only achieved when respondents report positive states and evaluate their health favorably.

Ware (1993) suggests that three of the subscales (Physical Functioning, Role Functioning-Physical, and Bodily Pain) are largely measures of physical health status. He goes on to say that each subscale addresses a different aspect of physical health. The Physical Functioning subscale measures limitations in behavioral performance of everyday physical activities, the Role Functioning-Physical subscale measures the extent of disability in everyday activities, and the Bodily Pain subscale measures the severity of bodily pain and resulting limitations in activities. For these subscales, the highest possible score is achieved when no limitations or disabilities are observed.

As would be expected for a group of patients recovering from cardiac surgery, the mean scores for the Role Functioning-Physical (37.42) and the Vitality (57.06) subscales are quite low, indicating that these respondents were significantly limited in their everyday activities in the postoperative period after CABG surgery. The majority of patients reported that they were limited in the type of activities that they could participate in and the amount of time that they could spend on certain activities. However, they did not feel that they were accomplishing less than they preferred. Indeed, in the early convalescent period after CABG surgery, patients are instructed to limit certain physical activities such as lifting objects over 10 pounds. Thus, while the patients subjectively voiced relative freedom from disability or limitations in general physical performance, their responses reflected compliance with advice of the medical staff to limit their activities.

The CABG surgical patients' mean score on the Physical Functioning subscale is 64.05 with a standard deviation of 18.69. While the respondents had little difficulty walking several blocks, bathing themselves, climbing a flight of stairs or even moderate activities such as moving a table or pushing a vacuum cleaner, they were almost universally limited in vigorous activities such as running, lifting heavy objects, and participating in strenuous sports. Yet, the majority of respondents were able to walk more than a mile.

The mean score on the Bodily Pain subscale is 63.74 with a standard deviation of 21.98. Most CABG surgical patients reported having no bodily pain during the previous week. A number of individuals complained of pain in the graft donor leg but few had pain from the sternotomy. Several patients reported significant joint pain in their extremities due to osteoarthritis and not CABG surgery.

The three best measures of the mental health component of health status are thought to be the Mental Health, the Social Functioning, and the Role Functioning-Emotional subscales. They differ in the range of mental health measured, with perfect Social Functioning and Role

Functioning-Emotional subscale scores earned by those reporting no limitations or disability due to personal or emotional problems. Conversely, the Mental Health subscale is a bipolar subscale with a mid-range score earned by those reporting no symptoms of psychological distress. A score of 100 on this subscale requires reports of frequently feeling happy, calm, and peaceful.

The CABG surgical patients were, in general, reasonably happy, calm, and peaceful after surgery as demonstrated by a mean Mental Health subscale score of 76.71. The scores on the Mental Health subscale are very negatively skewed indicating that few people reported feeling anxious, down in the dumps, or blue after surgery. A small percentage of CABG surgical patients reported feeling down in the dumps for reasons unrelated to surgery. For example, some patients were caring for invalid spouses or delinquent children. Others were facing loss of employment or other financial burdens. Still others suffered from chronic diseases such as multiple sclerosis, chronic back pain, and osteoarthritis. One patient had been HIV positive for several years.

The mean score on the Social Functioning subscale is 77.16 with a standard deviation of 22.34. Thirty three percent of the patients reported no interference at all in their social activities due to physical or emotional problems. Of the total sample, 90% reported a score of 50 or greater on this subscale.

The Role Functioning-Emotional subscale mean score is 70.70 with a median and modal value of 100. This subscale has the largest variance and the largest standard error of all the subscales. A number of patients found this three-part question confusing, largely due to the placement of the item in the questionnaire. This item immediately follows a similar item which inquires about physical rather that emotional problems. If the respondent wasn't attentive to the underlined words emotional problems, they responded as if the item was asking about limitations as a result of their physical health. This confusion was solved once the question was reread verbatim.

The Vitality and General Health Perceptions subscales are deemed to be sensitive to both physical and mental health outcomes. A mid-range score on the Vitality subscale is achieved by those who do not report feeling tired or worn out. This is the case for the CABG surgical patients who have a mean subscale score of 57.06. A score of 100, in addition to indicating an absence of these symptoms, is only achieved by those who report feeling full of pep and energy all of the time. This would be an unrealistic score for patients in an early convalescence period (mean=57.3 days) after cardiac surgery.

A mid-range score is obtained on the bipolar General Health Perceptions subscale by reporting no unfavorable evaluations of health in general. The mean subscale score for the CABG surgical patients is 70.48 with the lowest standard deviation of all the subscales (16.51). The scores on this subscale are negatively skewed with a modal score of 82. The majority of patients rated their health as good and at least as good as anybody they knew. Moreover, most patients reported that they expected their health to improve in the future.

Item 2 in the SF-36 Health Survey is not used to score any of the eight subscales. This item is included to estimate change in health status. The questions asks, "Compared to one week ago, how would you rate your health in general now?" Table 5.2 provides the distribution of the responses from the CABG surgical patients. In the early convalescent period after CABG surgery, 97.7% of patients judged their health as good or better than it had been the previous week. Only one patient felt much worse than the previous week.

Table 5.2

Responses to The Health Transition Item Of The SF-36

Reported Transition	**Frequency**	**Percent**
Much better	60	19.6
Somewhat better	127	41.5
About the same	112	36.6
Somewhat worse	6	2.0
Much worse	1	0.3

The Correlations Among The SF-36 Subscales

The correlations between the subscales of the SF-36 Health Survey are shown in Table 5.3. The highest correlation in the matrix is between the Vitality subscale and the General Health Perceptions subscale (.53). The Vitality subscale also correlates moderately with the Physical Functioning subscale (.52).

A cluster of moderate correlations involving the Mental Health subscale is evident. The Mental Health subscale moderately correlates with the Social Functioning subscale (.52), the Role Functioning-Emotional subscale (.52) and the Vitality subscale (.51). The pattern of the correlations among the mental component of health (Mental Health, Social Functioning, Role Functioning-Emotional) is quite consistent.

The correlations between the subscales measuring the physical components of health (Role Functioning-Physical, Bodily Pain, and Physical Functioning) are somewhat less strongly correlated (.34 to .42). The lowest correlation in the matrix is between the Role Functioning-Physical subscale and the General Health Perceptions subscale. The correlation between the Physical Functioning and Mental Health subscales is 0.30, larger than the correlation of 0.17, previously reported (Ware, 1993, p. 9:18).

Overall, the pattern of correlations suggests the hypothesized two-dimensional structure of the SF-36 Health Survey. In general, the Mental Health, the Social

Table 5.3

Correlations Among the SF-36 Health Survey Subscales

Subscale	PF	RP	BP	GH	VT	SF	RE	MH
Physical Functioning	1.00	.4274	.3425	.3956	.5251	.3574	.2381	.2967
Role-Physical		1.00	.3742	.1771	.3979	.2822	.3085	.2396
Bodily Pain			1.00	.3542	.4262	.3682	.3330	.3017
General Health				1.00	.5319	.3869	.2924	.4422
Vitality					1.00	.4815	.3345	.5115
Social Functioning						1.00	.4166	.5241
Role-Emotional							1.00	.5190
Mental Health								1.00

n=306

Functioning, and the Role Functioning-Emotional subscales reflect the mental component of health, and somewhat less convincingly, the Physical Functioning, the Role Functioning-Physical, and the Bodily Pain subscales reflect the physical component of health. The General Health Perceptions and the Vitality subscales correlate more highly with each other than with either of the two hypothesized dimensions of health.

Factor Analysis of the SF-36 Subscales

Included in the presentation of the descriptive statistics for the SF-36 health Survey subscales was a discussion of two major dimensions of health - physical and mental. An explicit assumption underlying the conceptualization of the SF-36 Health Survey is that this instrument measures two broad categories of health. To explore this assumption, the SF-36 subscales were subjected to a variety of factor analytic methods in order to test the hypothesized two-dimensional structure of health - physical and mental. For the sake of comparison with previous research, principal component factor analysis was implemented first.

The goal of factor analysis is finding out if meaningful constructs underlie a larger set of manifest variables. The results of the factor analyses, described below, fail to support the hypothesized dimensionality of the SF-36 Health survey. That is, a convincing factor model with either one, two, or three factors extracted, that supports the hypothesis of a mental and a physical component of health was not found. Therefore, this section ought to be read as documentation of an inability to justify a two factor model and which will have little continuity with the LISREL models which follow. In the end, it was resolved to treat the SF-36 subscales as separate concepts in these LISREL models.

The SF-36 subscales were first subjected to a principal component factor analysis which is applied to the correlation matrix with unities as diagonal elements. The factors then give the best least squares fit to the entire correlation matrix and each succeeding factor accounts for the maximum amount of the variance remaining at that stage of the factoring process. Because the main diagonal of the correlation matrix is set to one, the procedure attempts to account for all the variance of each variable regardless of its source. Both a two-factor and a three-factor model was fitted.

Table 5.4 provides the unrotated factor loadings for the SF-36 subscales when two factors were requested. The eigenvalues and eigenvectors of the correlation matrix are the essence of a principal components analysis. With the correlation matrix displayed in Table 5.2 as the input data, a principal components analysis was used to investigate the hypothesized dimensionality of the SF-36 subscales. As suggested by previous research, two factors were requested first. The reported eigenvalues are, in descending order, 3.67, 0.996, 0.849, 0.665, 0.555, 0.478, 0.423, and 0.359. To facilitate interpretation, the components were rotated to orthogonal simple structure using the varimax method.

Table 5.4

The SF-36 Health Survey: Unrotated Principal Component Factors

Scale	**Factors** I	II	h^2
PF	.659	.449	.635
RP	.571	.562	.641
BP	.638	.217	.454
GH	.671	-.143	.471
VT	.794	.099	.641
SF	.716	-.257	.579
RE	.628	-.358	.523
MH	.720	-.456	.726
SS* (eigenvalues)	3.673	.996	4.669
% of 4.669	78.6%	21.3%	
% of Total Variance	45.9%	12.4%	

* SS = sums of squares

The results illustrated in Table 5.4 are fairly consistent with the results found by others (McHorney, Ware, & Raczek, 1993); correlations (loadings) between the subscales of the SF-36 and the first unrotated component reveals that a large general factor is common to all eight subscales. However, a "general" factor can be expected from an unrotated matrix when the correlation matrix contains mostly positive correlations. The percentage of common variance accounted for by the first factor is 78.6%. That is, of the common variance represented in the correlation matrix, 78.6% of this variance is accounted for by the first factor alone. Because the percentage is so high one might decide to retain and interpret only the first factor. However, it is not a common practice to interpret an unrotated matrix.

Table 5.5 provides the rotated solution which shows the correlation of each subscale with the hypothesized physical and mental health dimensions. The rotated solution indicates that the first factor represents primarily 4 subscales (General Health Perceptions, Social Functioning, Role Functioning-Emotional, and Mental Health). This factor, which appears to represent the mental health component, accounts for 54.5% of the common variance. The second factor is largely defined by the remaining four subscales (Physical Functioning, Role Functioning-Physical, Bodily Pain, and Vitality). This factor, which could be labeled physical health, accounts for 45.5% of the common variance. However, the Vitality subscale correlates almost equally well with both factors. Similarly, the General Health Perceptions subscale appears to load on both factors with a somewhat larger correlation with the mental health factor.

Table 5.5

The SF-36 Health Survey: Varimax Rotated Factors

Principal Components Analysis

Scale	**Factors**		
	Mental	Physical	h^2
PF	.209	.769	.635
RP	.069	.798	.641
BP	.344	.579	.454
GH	.603	.327	.471
VT	.540	.591	.641
SF	.711	.270	.579
RE	.710	.136	.523
MH	.844	.121	.726
SS	2.544	2.126	4.669
% of 4.669	54.5%	45.5%	
% of Total Variance	31.8%	26.6%	

The orthogonal rotation of the SF-36 also reveals that the communalities of the General Health Perceptions (.471) and Bodily Pain (.454) subscales are significantly lower than those previously reported (McHorney et al., 1993). Because this is an orthogonal rotation the factor loadings can be interpreted as correlations. That is, the correlation between the Physical Functioning subscale and the physical factor is 0.769.

In the orthogonal rotation, the model assumes that the factors are uncorrelated. However, an oblique solution, permitting the factors to covary, was performed because the zero order correlation between the Physical Functioning subscale and the Mental Health subscale is 0.30, higher than the 0.17 correlation previously reported (Ware, 1993, p. 9:18). In other words, by doing an oblique rotation, the hypothesis that the physical and mental components of health might be correlated is investigated.

Table 5.6 presents the results of a promax oblique rotation which uses the varimax orthogonal rotation as a basis for its solution. This rotation results in a greater separation between high and low loadings. Therefore, simple structure is more evident. Factor I and Factor II, indeed, correlate moderately (.545).

An advantage of the varimax-promax sequence is that they provide a basis for determining whether orthogonal or oblique factors are more acceptable. If the correlations among the oblique factors are negligible, then the varimax solution is accepted as a reasonable solution. Else, the oblique solution is the choice -- as in this case, given the correlation between the factors. Comparing orthogonal and oblique solutions encourages selection of the simpler uncorrelated factor model if that is actually reasonable. Regarding the SF-36, theory and previous research suggested that the subscales representing the mental and physical components of health ought to be considered as "relatively pure" (McHorney et al., 1993) and that an orthogonal factor solution was the most appropriate (Ware, 1993). However, the results of the oblique rotation determine that these are not uncorrelated factors. Therefore, the hypothesized two-dimensional orthogonal factors cannot be supported.

Table 5.6

The SF-36 Health Survey: Promax Oblique Rotated Factors

Principal Components Analysis

Pattern on Primaries

Scale	**Factors**		
	Mental	Physical	h^2
PF	-.020	.808	.635
RP	-.191	.889	.641
BP	.198	.545	.454
GH	.579	.169	.471
VT	.418	.492	.641
SF	.722	.067	.579
RE	.766	-.086	.523
MH	.924	-.149	.726
SS (direct Effect)	2.549	2.044	4.669
SS (Joint Effect)	0.766		
% of 4.669	54.6%	43.8%	
% Total Variance	31.9%	25.5%	

The matrix of the pattern on the primaries suggests that a two factor solution is interpretable but not unequivocally clear. The first factor can be labeled mental health since the Mental Health subscale has a high loading on that factor. The Social Functioning and Role Functioning-Emotional subscales also load somewhat less heavily on this factor and demonstrate very low loadings on the second factor. The pattern on the primaries also reveal that the Vitality subscale appears to load on both factors almost equally well. This is reasonable given that for these subjects vitality probably involves both a physical and a psychological component.

The Physical Functioning and the Role Functioning-Physical subscales have high loadings on the second factor which can be interpreted as physical health. The Bodily Pain subscale has a moderate loading on the physical factor and a low loading on the mental health factor. The General Health Perceptions subscale loads more heavily on the mental health factor than the physical health factor. In contrast, McHorney et al. (1993) found that the General Health Perceptions subscale correlated more highly with the physical component of health. There are no communalities less than 0.2 that would indicate a serious problem of defining any subscales within the space defined by the two factors selected. However, the communalities for the Bodily Pain and the General Health Perceptions subscales are not as high as the rest of the subscales. The first factor accounts for 54.6% of the common variance and the second factor accounts for 43.8%. The joint contribution of these correlated factors is about 1.6% of the common variance.

As a check on the dimensionality of the SF-36 Health Survey subscales a three factor principal component factor analysis was performed. An orthogonal varimax rotation was performed on these three factors, the results of which appear in Table 5.7. The communalities for all eight subscales are larger than in the two factor solution.

The first three subscales (Physical Functioning, Role Functioning-Physical, Bodily Pain) load on factor II while the last three subscales (Social Functioning, Role Functioning-Emotional, Mental Health) load on factor I. The Social Functioning and Mental Health subscales, however, also load on factor III; this obscures the interpretation of the factors.

Similarly, the Physical Functioning subscale loads on both factor II and factor III. The Bodily Pain subscale has non-zero loadings on all three factors. Finally, only two subscales (General Health Perceptions and Vitality) load heavily on factor three. However, the Vitality subscale also has non-zero loadings on all three factors. Therefore, it would appear that, on the basis of simple structure, a three factor orthogonal solution is more difficult to justify than the two factor solution. The identity of the third factor, although interpretable, is not particularly helpful because the three subscales which have moderate loadings on it also have loadings on the two other factors.

Table 5.7

The SF-36 Health Survey: Three Factor Varimax Rotation Principal Components Analysis

Scale	Factors I	II	III	h^2
PF	-.007	.585	.588	.689
RP	.167	.886	.024	.813
BP	.309	.552	.275	.476
GH	.247	.023	.833	.756
VT	.294	.383	.686	.704
SF	.614	.190	.409	.581
RE	.841	.253	-.008	.771
MH	.753	.047	.399	.729
SS	1.922	1.682	1.914	5.518
% Common	34.8%	30.5%	34.7%	
% Total	24.0%	21.0%	23.9%	

A promax oblique rotation was undertaken, allowing the factors to be correlated. The results of this rotation can be found in Table 5.8. Examining the pattern on the primaries suggests that there is little to be gained by extracting three factors over extracting two factors. Three subscales load on factor I (Physical Functioning, General Health Perceptions and Vitality) and three subscales (Social Functioning, Role Functioning-Emotional, and Mental Health) load on factor II. The third factor is represented by three subscales (Physical Functioning, Role Functioning-Physical and Bodily Pain). In general, there is less evidence for simple structure in a three factor space. The first factor accounts for 34.6% of the common variance while the second and third factors account for 31.7% and 27.8% of the variance, respectively. The three factors are correlated about 0.42.

Table 5.8

SF-36 Health Survey: Three Factor Promax Oblique Rotation Principal Components Analysis

Pattern on Primaries

Scale	**Factors** I	II	III	h^2
PF	.579	-.240	.504	.689
RP	-.172	.062	.945	.813
BP	.153	.198	.501	.476
GH	.915	.052	-.204	.756
VT	.667	.095	.219	.704
SF	.312	.549	.032	.581
RE	-.234	.902	.170	.771
MH	.298	.725	-.141	.729
SS (Direct)	1.912	1.752	1.536	5.518
SS (Joint)	0.3184			
% Common	34.6%	31.7%	27.8%	
% Total	23.9%	21.9%	19.2%	

How Many Factors Underlie The SF-36 Subscales?

It is difficult to elucidate how many factors underlie the SF-36 subscales. Two types of solutions have been developed in response to the problem of how many factors to extract. One is Guttman's image analysis, which provides a unique solution from a psychometric basis, and the other is maximum likelihood factor analysis which provides a statistical basis for the number of factors.

Image analysis has a very sound psychometric basis in terms of factor analytic models. The lower bound to the communality is the squared multiple correlation (SMC). More importantly, this model assumes that as the number of tests increase that the number of factors stabilize at some finite value rather than continually increasing. This position is in contrast to the maximum likelihood method of factoring, which as with most statistical procedures, determines statistical significance, and therefore the number of factors, as a function of the sample size. Thus, under maximum likelihood tests for the number of factors, the greater the number of subjects, the greater the number of factors, regardless of their interpretability, which must be considered significant.

Several methods of factor analysis were performed on the SF-36 Health Survey subscales including principal axis factor analysis, unweighted least squares factor analysis, generalized least squares factor analysis, image analysis, and maximum likelihood factor analyses. Only the latter two methods are discussed here.

In principal components analysis the components are expected to explain all the variance, without considering whether it reflects processes that are general to all measures or specific to only one, or whether they reflect measurement error (Cliff, 1987). The procedures of common factor analysis, such as image analysis, on the other hand, try to separate out that portion of the variance that is unique to a measure, and then to explain the remaining variance. Cliff (1987) asserts that "Militant common-factorists insist that components analysis is at best a common factor analysis with some error added and at worst an unrecognizable hodgepodge of things from which nothing can be determined" (p. 349).

In an image analysis the matrix which is factored is not the regular correlation matrix, but rather the matrix of covariances among the common parts. The common part of the variable is called the image of the variable based on all the other variables in the universe of variables (Mulaik, 1972, p. 186). The unique part of the variable, the anti-image, is the part remaining which cannot be predicted by all the other variables in the set of variables by multiple correlation.

The image covariance matrix which is factored contains SMCs on the diagonals and the off diagonals are covariances among the common parts of the tests only (bounded by +1.0 and

-1.0). The matrix is Gramian, and thus no negative eigenvalues appear. While one could argue that an image analysis throws away valuable information by excluding uniqueness and unexplained error, any time a matrix with unities on the diagonals is factored, one is attempting to reproduce the total variance. There is, however, no guarantee that the communalities will not include some amount of uniqueness or measurement error. If one is concerned with the part of the variables which are common in order to determine the underlying dimensions, it would appear that an image analysis will provide a clearer answer with only communalities on the diagonals of the matrix to be factored.

The unrotated orthogonal image analysis factor loading matrix for the SF-36 subscales is found in Table 5.9. The communalities (SMCs) resulting from an image analysis are lower than for other methods of factor analysis because only the common variance is being factored. The eigenvalues are very distinct (2.56 & 0.14) and they suggest the presence of only one factor which is why no simple structure is evident in the varimax solution which follows. The SMCs, which reflect the amount of variance which is common, are the same values as the communalities (see Table 5.9).

Table 5.9

The SF-36 Health Survey: Unrotated Orthogonal Factors

Image Factor Analysis

Scale	Factors		
	I	II	h^2
PF	.543	.154	.318
RP	.458	.175	.240
BP	.515	.090	.274
GH	.567	.039	.323
VT	.681	-.018	.465
SF	.599	-.086	.366
RE	.512	-.249	.324
MH	.623	-.066	.392
SS (eigenvalues)	2.564	.138	2.702
Percent of 2.702	94.9%	5.1%	

The varimax factor loading matrix for the SF-36 Health Survey is provided in Table 5.10. It is evident that the variance has been spread more evenly over the two factors. The varimax rotation fails to provide evidence of simple structure since several subscales have substantial loadings on both factors. The Vitality and the Mental Health subscales load equally well on both factors. The first factor, labeled physical, accounts for 52.6% of the common (and total) variance and the second factor, labeled mental, accounts for 47.4% of the common variance.

Table 5.10

The SF-36 Health Survey: Varimax Rotated Factors

Image Factor Analysis

Scale	**Factors**		
	Physical	Mental	h^2
PF	.500	.260	.318
RP	.453	.187	.240
BP	.436	.288	.274
GH	.439	.361	.323
VT	.483	.481	.465
SF	.376	.473	.366
RE	.202	.532	.324
MH	.408	.475	.392
SS	1.421	1.281	2.702
Explained variance	52.6%	47.4%	

The high correlation between the two factors (0.831), when an promax oblique rotation was performed, suggests that they are not independent. The three strongest loadings on the first factor are the Physical Functioning, Role Functioning-Physical, and Bodily Pain subscales (see Table 5.11). The three strongest loadings on the second factor come from the Social Functioning, Role Functioning-Emotional, and Mental Health subscales. However, the Mental Health subscale loads (0.235) on the first factor as well. Two subscales, General Health Perceptions and Vitality, load on both factors. The communalities, which remain invariant with an oblique rotation, are quite low for the Role Functioning-Physical and Bodily Pain subscales suggesting that they are not well explained in a two factor space. However, the communalities are SMCs in an image factor analysis and must, therefore, be judged accordingly. The first factor accounts for 44.6% of the common variance while the second factor accounted for 37.7% of the common variance.

Table 5.11

The SF 36 Health Survey: Promax Oblique Rotation

Image Factor Analysis

Pattern on Primaries

Scale	**Factors**		
	Physical	Mental	h^2
PF	.567	-.003	.318
RP	.555	-.081	.240
BP	.442	.095	.274
GH	.384	.208	.323
VT	.350	.363	.465
SF	.187	.440	.366
RE	-.139	.680	.324
MH	.235	.417	.392
SS (direct)	1.204	1.020	2.702
SS (joint)	0.4787		
% Common	44.6%	37.7%	
% Total	15.0%	12.7%	

The image analysis and the principal components analysis of the SF-36 reveal similar information regarding the number of underlying factors. The eigenvalues point to one large factor and a smaller second factor. If one decided to accept only factors with eigenvalues greater than one, regardless of the factor analytic method, then one factor would be the acceptable choice. However, the second factor is interpretable even if not persuasive.

The final factor analytic method used to analyze the SF-36 Health Survey subscales is that of maximum likelihood estimation. The unrotated factor loading matrix for this analysis is found in Table 5.12 and the varimax rotated factors are found in Table 5.13.

Table 5.12

The SF-36 Health Survey: Unrotated Factors

Maximum Likelihood Factor Analysis

Scale	**Factors**		
	I	II	h^2
PF	.567	.419	.497
RP	.456	.317	.308
BP	.519	.227	.321
GH	.606	.096	.377
VT	.749	.233	.615
SF	.659	-.029	.436
RE	.575	-.162	.356
MH	.788	-.372	.760
SS (eigenvalues)	3.115	.557	3.673
% Common	84.8%	15.2%	
% Total	38.9%	6.9%	

Consistent with the other factoring methods, Table 5.12 exhibits one large factor and a less significant second factor. In the orthogonal rotated factor matrix, three subscales (Physical Functioning, Role Functioning-Physical, and Vitality) load strongest on the first factor (see Table 5.13). However, simple structure is complicated by the loadings on the second factor. Moreover, the Bodily Pain subscale has both a moderate loading on the first factor (.501) and a weak loading (.266) on the second factor. Three subscales load primarily on the second factor (Social Functioning, Role Functioning-Emotional, and Mental Health). The Social Functioning subscale, however, also has an unexpected loading on the first factor (.387). The General Health Perceptions subscale loads almost equally well on both factors and the Vitality subscale loads somewhat stronger on the first (physical) than the second factor. The first factor accounts for 50% of the common variance while the second factor accounts for 49% of the common variance.

Table 5.13

The SF-36 Health Survey: Varimax Rotated Factors

Maximum Likelihood Factor Analysis

Scale	**Factors**		
	Physical	Mental	h^2
PF	.681	.183	.497
RP	.532	.160	.308
BP	.501	.266	.321
GH	.452	.415	.377
VT	.648	.442	.615
SF	.387	.535	.436
RE	.231	.551	.356
MH	.198	.849	.761
SS	1.86	1.8	3.67
% Common	50.1%	49.2%	
% Total	23.25%	22.5%	

An oblimin oblique rotation appears in Table 5.14. The two extracted factors correlate 0.623. Five subscales load heavier on the first than the second factor (Physical Functioning, Vitality, General Health Perceptions, Role Functioning-Physical, and Bodily Pain). However, the Vitality and General Health Perceptions subscales also load on the second factor. The three subscales with the strongest loadings on the second factor include the Social Functioning, the Role Functioning-Emotional, and the Mental Health subscales. However, of these, only the Mental Health subscale demonstrates a high loading. The Social Functioning subscale also loads on the first factor. Therefore, although two factors are interpretable, there is clear evidence for only one large factor.

The chi square statistic is 40.43 (p=0.0001) with 13 degrees of freedom. This significant chi square suggests that a two factor model does not fit the data well. While the chi square statistic is affected by sample size, the size of the sample in this study (N=306) was not likely large enough to be a factor in contributing to the significant result. Hayduk (1987) suggests that chi square results based on sample sizes between 50 and 500 can be reliably informative. Therefore, the conclusion drawn from the significant chi square is that the two factor model does not fit the data adequately.

Table 5.14

The SF-36 Health Survey: Oblimin Oblique Rotation

Maximum Likelihood Factor Analysis

Pattern on Primaries			
Scale	**Factors**		
	Physical	Mental	h^2
PF	.755	.084	.497
RP	.582	.045	.308
BP	.503	-.095	.321
GH	.385	-.295	.377
VT	.612	-.239	.615
SF	.258	-.468	.436
RE	.061	-.557	.356
MH	-.096	-.929	.761
SS (direct)	1.76	1.55	3.67
SS (joint)	.3532		
% Common	48.1%	42.4%	
% Total	22.0%	19.4%	

Inspection of the residual covariance matrix can provide more useful information about the fit of the model to the data than is obtained from the chi square test. Since only one residual has a value greater than 0.1, it is doubtful that extracting another factor to fit the data would be interpretable. In fact, when three factors were extracted, an insignificant chi square resulted. With 7 degrees of freedom, the chi square statistic was 8.54 (p=0.287). However, the third extracted factor demonstrated only one substantial loading -- that of the Role Functioning-Physical subscale.

A reasonable deduction drawn from the comprehensive factor analyses of the SF-36 Health Survey is that only one prominent factor, with the only substantial eigenvalue, underlies the SF-36 subscales. Yet a one factor model fails to fit the data. Two or three factor solutions fair no better even if the factors can be named and reasonably interpreted. In none of the factor analyses performed was it possible to find a definitive one, two, or three factor model. Although the interpretation of two factors is reasonably consistent with previous research, differences between the characteristics of this sample and those of the American norm sample could explain the discrepancies in the factor analysis results of this study versus those of the norm sample. Given this unfruitful attempt to find a parsimonious solution of how the SF-36 subscales relate to one another, the analysis turned to a comprehensive exploration of the profile of subscale scores. Subsequently, a more detailed analysis of the relationship between the subscale scores of the SF-36 and the concept QOL ensued.

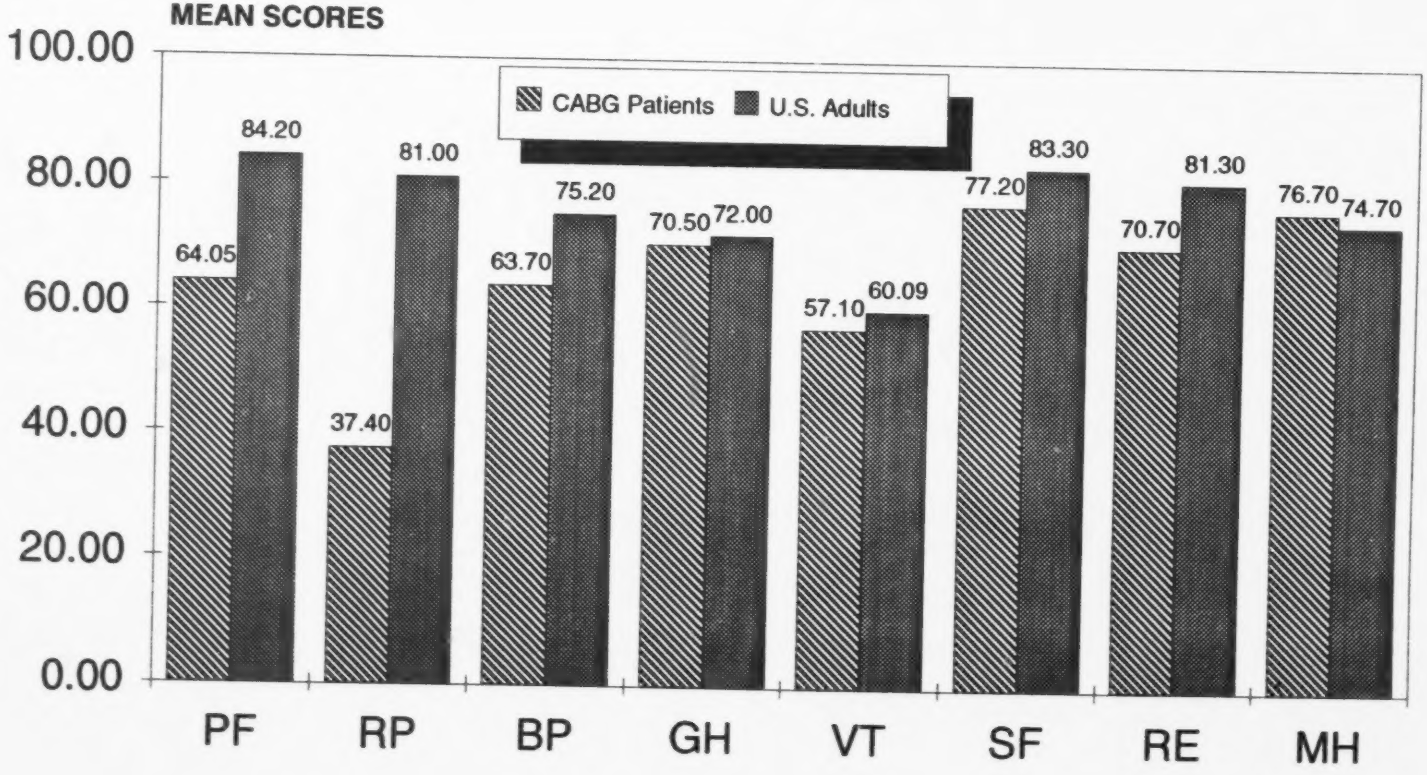
The SF-36 Health Profile of CABG Surgical Patients

Owing to the difficulty in finding a convincing factor model to account for the subscales of the SF-36 the focus of the analysis shifts to displaying and interpreting the subscales as a profile of scores. Interpreting the eight subscales as a profile has, in previous research, been useful for comparing scores of individuals with different mental and physical conditions. Figure 5.1 illustrates a comparison of profiles between the CABG surgical patients of the present study and the American norm sample.

The highest scores of the American norm sample are achieved for subscales which require only the absence of limitations to achieve the maximum score (Physical Functioning, Role Functioning-Physical, Bodily Pain, Social Functioning, and Role Functioning-Emotional). The mean subscale scores for the CABG surgical patients are generally lower than those of the norm sample of the U.S. population, particularly for the Physical Functioning, Role Functioning-Physical, Bodily Pain, and Role Functioning-Emotional subscales. Mean scores are similar for both groups on the General Health Perceptions, the Vitality, and the Mental Health subscales. The standard deviations of all the subscale scores are similar for both groups.

The CABG surgical patients' scores on the Physical Functioning and Role Functioning-Physical subscales are substantially lower than those of the norm sample, which is reasonable, given the early phase of surgical recovery. They reported less limitations on the Bodily Pain and Role Functioning-Emotional subscales, and even fewer, on the Social Functioning subscale. The three subscales thought to measure the well-being end of the health spectrum (General Health Perceptions, Vitality, and Mental Health) display strikingly similar scores to those of the norm sample. That

Figure 5.1 SF-36 Health Profile Of CABG Surgical Patients versus U.S. Adults



is, the scores of the CABG surgical patients, on these subscales, reflect a trend toward a positive evaluation of health despite the perception of physical limitations.

Phillips and Lansky (1992) found that, in a group of 100 heart valve surgical patients, the scores on seven of the eight subscales were well below the norm one month after surgery. The scores on the General Health Perceptions subscale equaled the norm value as they did in the present study. By the sixth postoperative month the valve replacement patients provided a profile very similar to the profile for the CABG surgical patients.

Presenting the SF-36 subscales as a profile of scores is useful for understanding the perceived health status of a group of recovering CABG surgical patients along eight separate dimensions of health. Cognizant of the failed attempt to explicate the factor structure of the SF-36, the logical means of exploring the relationship between health and QOL now focuses on examining the predictive effect of each subscale on the patients' perceptions of QOL. Moreover, the subscales are allowed to correlate among one another in the LISREL models discussed in the next section.

LISREL Models Of The Effects of Perceived Health On Quality of Life

A major goal of this study is to examine the construct-related validity evidence of perceived health and perceived QOL -- as separate and identifiable constructs as opposed to an emerging hybrid known as Health-Related Quality of Life (HRQOL). The hybridization of these entities courts confusion of the two separate constructs - a confusion which is reflected in the following passages:

> Health status and quality of life are often used to describe an individual's or a group's functional status at a single point in time (Patrick & Erickson, 1993, p. 21).

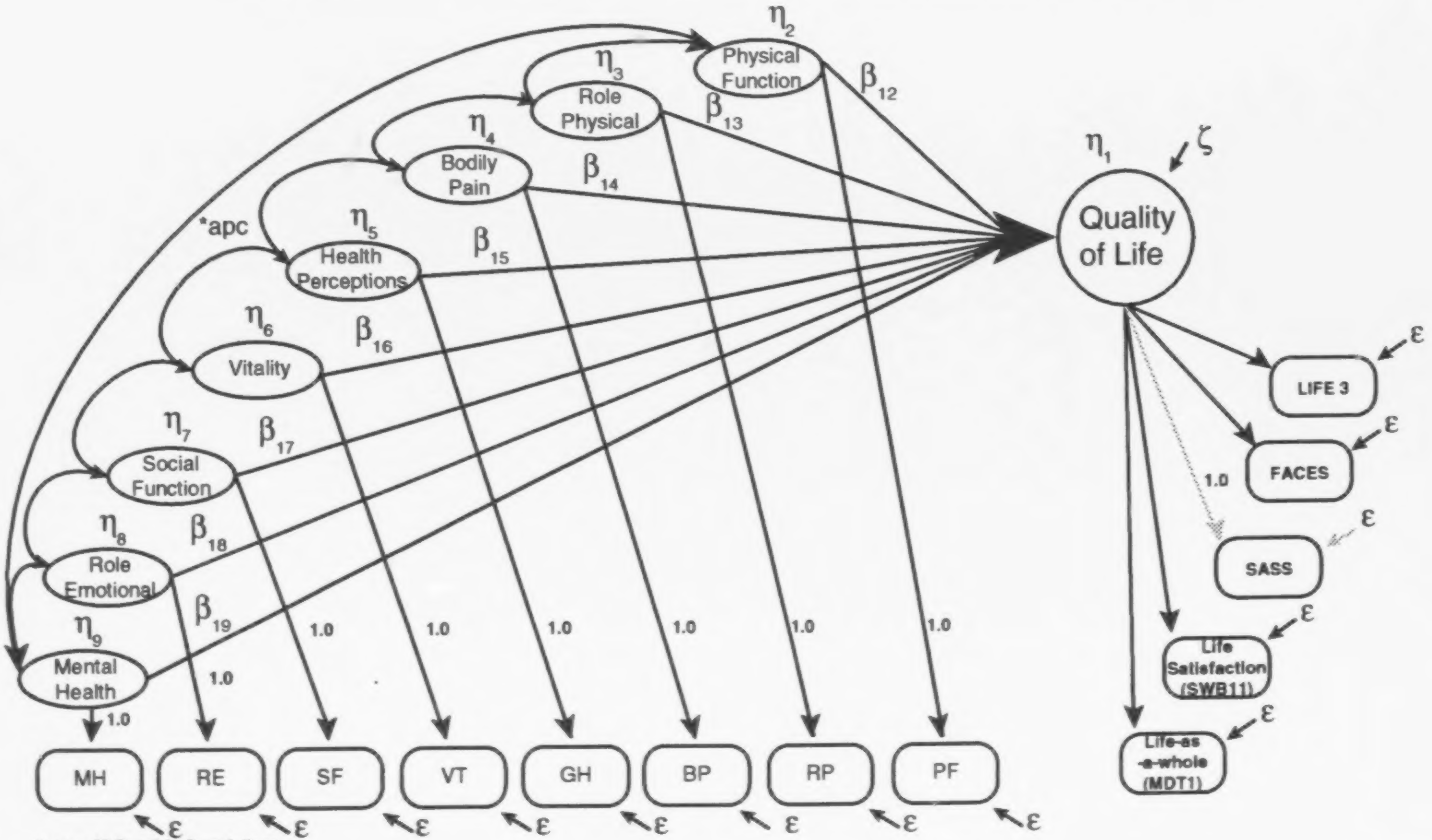
> Because "quality of life" represents the broadest range of human experience, use of this general term in the health field has led to considerable confusion, particularly because of the overlap with the older, more specific concept of health status. To make the meaning more specific and still retain the important aspects of life quality, the term "health-related quality of life" is both useful and important. Health-related quality of life is the value assigned to duration of life as modified by the impairments, functional states, perceptions, and social opportunities that are influenced by disease, injury, treatment, or policy (Patrick & Erickson, 1993, p. 22).

The question regarding the nature of the relationship between perceived health and perceived quality of life (QOL) is addressed even in the SF-36 Health Survey manual (Ware, 1993, p. 9:23). Ware found that the SF-36 subscales correlated positively and significantly with a QOL measure from the General Psychological Well-Being Measure (Dupuy, 1984). This measure asks each respondent "How happy, satisfied or pleased have you been with your personal life?" Six response choices are offered ranging from "extremely happy, could not have been more satisfied or pleased," to "very dissatisfied or unhappy most of the time." This item was found (Ware et al., 1979) to be substantially associated with the SASS item used in this study.

Structural equation modeling is used to extend the investigation of the predictive effects of the SF-36 subscales on QOL. There exists no theoretical postulates to guide the construction of a model which describes the causal relationship between health and QOL. An assumption underlying the specification of the models, examined below, is that health is a concept which is separate and unique from that of QOL. In fact, the model here is quite different from the more common assumption that health is an indicator or a dimension of QOL rather than a predictor of the concept. To state that health is a dimension of QOL is to avoid specificity regarding the causal sequence between the two concepts. Bollen and Lennox (1991), for example, discuss models with indicators as both causes and effects of latent variables. The stance taken in the present study is that the concept of health is a cause of rather than an effect of QOL.

The model of the relationship between perceived health and QOL (see Figure 5.2) investigates the potential causal links between each of the eight SF-36 health status concepts and the concept of QOL. It is hypothesized that the QOL of CABG patients is causally influenced by their perceptions of their health. Individuals who perceive each of the dimensions of their health in a positive way are predicted to evaluate the quality of their lives as superior.

Figure 5.2 Perceived Health and Quality of Life
Hypothesized Relationship Between The Concepts


η_1
ζ
Quality of Life
η_2
Physical Function
η_3
Role Physical
η_4
Bodily Pain
η_5
Health Perceptions
η_6
Vitality
η_7
Social Function
η_8
Role Emotional
η_9
Mental Health
*apc
β_{12}
β_{13}
β_{14}
β_{15}
β_{16}
β_{17}
β_{18}
β_{19}
1.0
MH
RE
SF
VT
GH
BP
RP
PF
ε
LIFE 3
FACES
SASS
Life Satisfaction (SWB11)
Life-as -a-whole (MDT1)

*apc = All Possible Correlations

The eight arrows leading to QOL from the eight health status concepts are effects (structural coefficients also called beta coefficients) to be estimated. If these eight dimensions of perceived health have no influence on QOL then the estimates of the structural coefficients corresponding to these arrows will be near zero and all the variance in the QOL concept will be attributed to unidentified or omitted variables collectively represented by an error variable.

Briefly, the measurement portion of the model in Figure 5.2 indicates that each of the health status concepts is linked to and measured by a single indicator, the corresponding observed SF-36 subscale score. By fixing the lambda coefficient between the health concepts and the corresponding observed indicators at 1.0, the scales on which the values of the concepts are measured are identical to the scales of the indicators. Thus, a unit change in the concept is scaled to be the same as a unit change in the indicator. The concepts have been operationalized in chapter III.

The measurement error variance for the observed SF-36 subscale scores was initially fixed at a value of 30% of their observed variance based on the investigator's impression of the accuracy of measurement of the health concepts and the observations of respondent behavior. Calculation of internal consistency reliability estimates with Hoyt's Anova method (Crocker & Algina, 1986) revealed values ranging from 0.69 for the General Health Perceptions subscale to 0.85 for the Vitality subscale. The 30% measurement error variance assigned to the observed subscale scores, considerably less than the error variance expected in the QOL indicators, was considered reasonable since years of psychometric work has been conducted on the SF-36 Health Survey.

The QOL concept has five observed indicators: the Life-as-a-Whole item (MDT1), the Faces Scale, the Self-Anchoring Striving Scale (SASS), the Life Satisfaction item (SWB11) of the Index of Well-Being (IWB) and the Life 3 Scale. The SASS item is used to scale the QOL concept and the remaining lambda coefficients are free to be estimated. The MDT1 item is the global life assessment item taken from Michalos' (1985) Multiple Discrepancies Theory (MDT). The Faces Scale was selected as a distinctly different method of measuring QOL compared to a typical questionnaire item in that pictures of various facial expressions are presented to the respondents. The SWB11 item, the last question of the IWB, was selected as a QOL measure because of the global nature of the item which is theoretically consistent with the conceptualization of QOL in the present study. The Life 3 Scale, which assesses life as a whole, is the mean value of two administrations of this item separated by about 40 minutes. The measurement error variances for the QOL indicators (with the exception of the SASS item) are free to be estimated with starting values equal to 50% of their observed variance. Consistent with an earlier discussion of the measurement of QOL, the correlation between the measurement errors for the Faces Scale and the SASS is free to be estimated.

In the model shown in Figure 5.2, the variances of and the covariances between, the eight health concepts are free to be estimated. The model makes no attempt to explain the sources of these health concepts but instead explores the effects of the health concepts on QOL. The maximum likelihood estimates for the first attempt to estimate the relationship between perceived health and perceived QOL are found in Table 5.15 and illustrated in Figure 5.3.

The LISREL output for this model indicates that the fit of the model is poor. The chi square with 37 degrees of freedom is 66.42 with probability 0.002. It is, therefore, unlikely that the sample covariance matrix would have been observed if the model in Figure 5.3 constituted the true population model. The goodness of fit index (GFI), which also depends on a comparison between the observed and model-implied covariance matrices, is 0.968. The adjusted goodness of fit index (AGFI) is 0.947 which indicates that the model is minimally incongruent with the data.

Examination of the standardized solution suggests a potential collinearity problem between the estimates of the effect of the Mental Health concept on QOL and the effect of the Role Functioning-Emotional concept on QOL. These concepts

Table 5.15 Maximum Likelihood Estimates of the Relationship Between Perceived Health And Quality of Life

Lambda Coefficients

	QOL	PF	RP	BP	GH	VT	SF	RE	MH
MDT1	.502								
Faces	.538								
SASS	1.0*								
SWB11	.590								
Life 3	.519								
PF		1.0*							
RP			1.0*						
BP				1.0*					
GH					1.0*				
VT						1.0*			
SF							1.0*		
RE								1.0*	
MH									1.0*

Beta Coefficients

	QOL	PF	RP	BP	GH	VT	SF	RE	MH
QOL		-.013	.002	.005	.020	-.004	-.003	-.016	.081

PSI

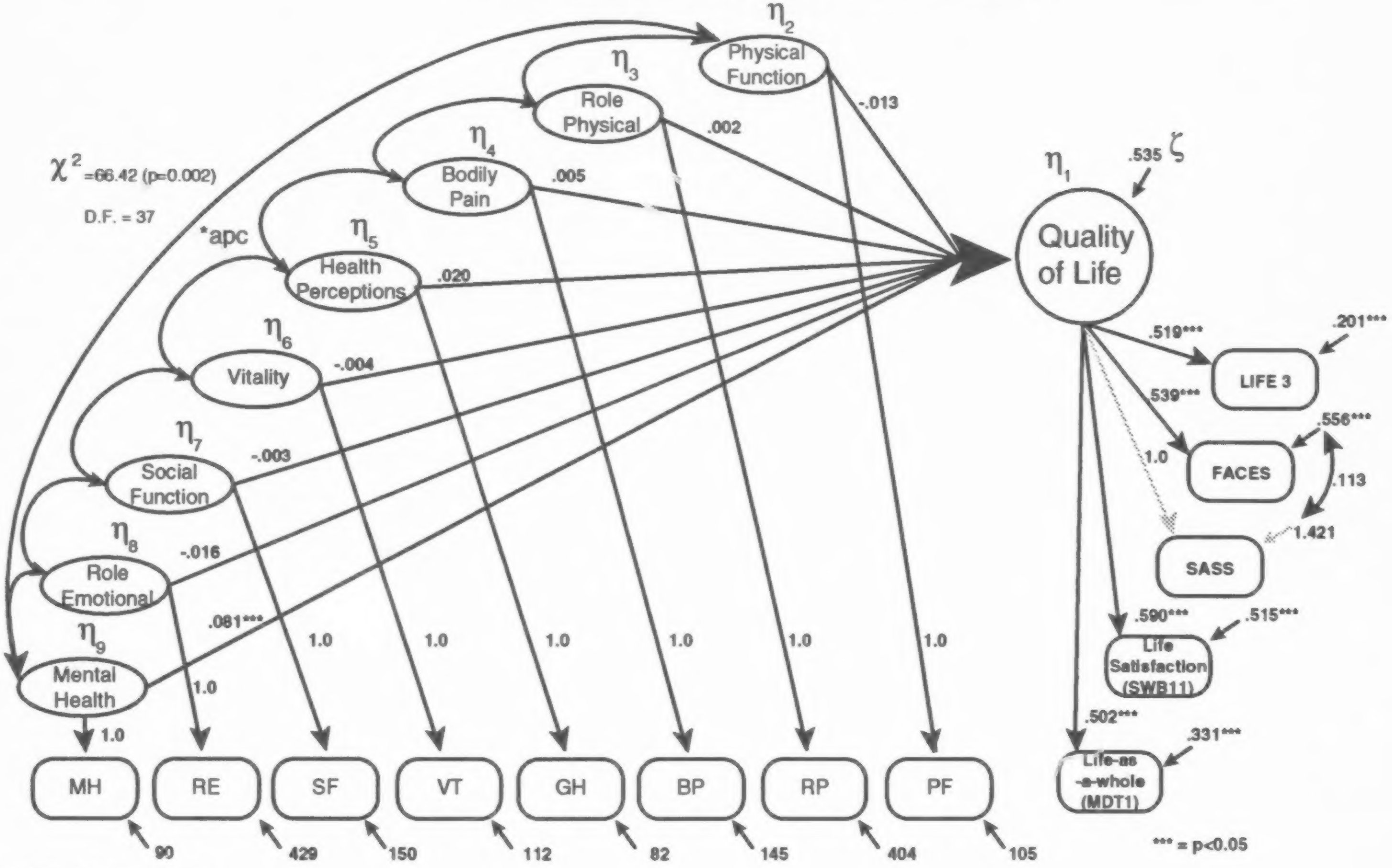
	QOL	PF	RP	BP	GH	VT	SF	RE	MH
QOL	.535								
PF		244.484							
RP		292.955	941.700						
BP		140.686	301.618	338.113					
GH		122.076	107.252	128.515	190.817				
VT		189.416	281.726	180.818	169.523	260.842			
SF		149.189	231.222	180.732	142.693	207.618	349.223		
RE		168.318	427.938	276.828	182.596	244.173	351.939	1001.251	
MH		96.015	152.189	114.834	126.442	171.001	202.729	339.927	209.920

(Theta Epsilon) Measurement Error Variance

	MDT1	Faces	SASS	SWB11	Life 3	PF	RP	BP	GH	VT	SF	RE	MH
MDT1	.331												
Faces		.556											
SASS		.113	1.421*										
SWB11				.514									
Life 3					.201								
PF						104.8*							
RP							403.6*						
BP								144.9*					
GH									81.8*				
VT										111.8*			
SF											149.6*		
RE												429.1*	
MH													90.0*

n=306 * = fixed coefficients

Figure 5.3 Perceived Health and Quality of Life Maximum Likelihood Estimates



χ^2 =66.42 (p=0.002)
D.F. = 37
*apc
η_2 Physical Function
η_3 Role Physical
η_4 Bodily Pain
η_5 Health Perceptions
η_6 Vitality
η_7 Social Function
η_8 Role Emotional
η_9 Mental Health
-.013
.002
.005
.020
-.004
-.003
-.016
.081***
η_1 Quality of Life
.535 ζ
.519***
.539***
1.0
.590***
.502***
LIFE 3
FACES
SASS
Life Satisfaction (SWB11)
Life-as -a-whole (MDT1)
.201***
.556***
.113
.421
.515***
.331***
1.0
MH
RE
SF
VT
GH
BP
RP
PF
90
429
150
112
82
145
404
105
*** = p<0.05

*apc = All Possible Correlations

correlate 0.74. Further, inspection of the matrix of the correlation among the estimates reveals that the estimates of the effect of the Mental Health and the Role Functioning-Emotional concepts on QOL correlate 0.872. Neither of these signs of collinearity are extreme, but rather, are in the borderline region. These LISREL diagnostics are being driven by the relatively high correlation between the Mental Health and the Role Functioning-Emotional concepts which is partially reflective of the conservative amount of specified measurement error variance.

The first model revision consisted of reducing the measurement error variance of the scores of the Mental Health subscale. This modification was reasonable since this subscale has received more extensive analysis than the other subscales. Moreover, the Hoyt estimate of reliability for this subscale is 0.83. The measurement error of the indicator of the Mental Health concept was reduced from 30% to 20% of the observed variance with an expected decrease in the correlation between the concepts of Mental Health and Role Functioning-Emotional and a resolution to the collinearity problem.

Noticeable improvements in the collinearity problem between the Mental Health and the Role Functioning-Emotional concepts resulted. The undesirable correlated estimates disappeared and the standardized beta estimate for the effect between the Mental Health and QOL concepts was reduced to a more reasonable value of 0.580 compared to the previous value of 0.982. When the measurement error variance of the Role Functioning-Emotional indicator (Hoyt reliability of 0.79) was also reduced to 20% of the observed variance, the standardized beta estimate for the effect of the Mental Health concept on QOL was even further reduced to 0.543. The LISREL output for this revision revealed an unchanged overall fit of the model. The chi square remained at 66.42 (p=0.002) with 37 degrees of freedom.

The remaining revisions to the model in Figure 5.2, depicting the relationship between perceived health and perceived QOL, were largely data driven. The first modification consisted of adding a coefficient to be estimated from the concept General Health Perceptions to the Life 3 indictor of QOL. When this lambda coefficient was estimated as -0.017, the T-value was statistically significant (t=-3.644, p<0.05). With 36 degrees of freedom the chi square for the model was improved at 50.46 (p=0.055). The AGFI was 0.959 and the squared multiple correlation (SMC) for the QOL concept was 0.609. In addition, the beta coefficient for the effect of the concept General Health Perceptions on QOL was now statistically significant where before it had not been.

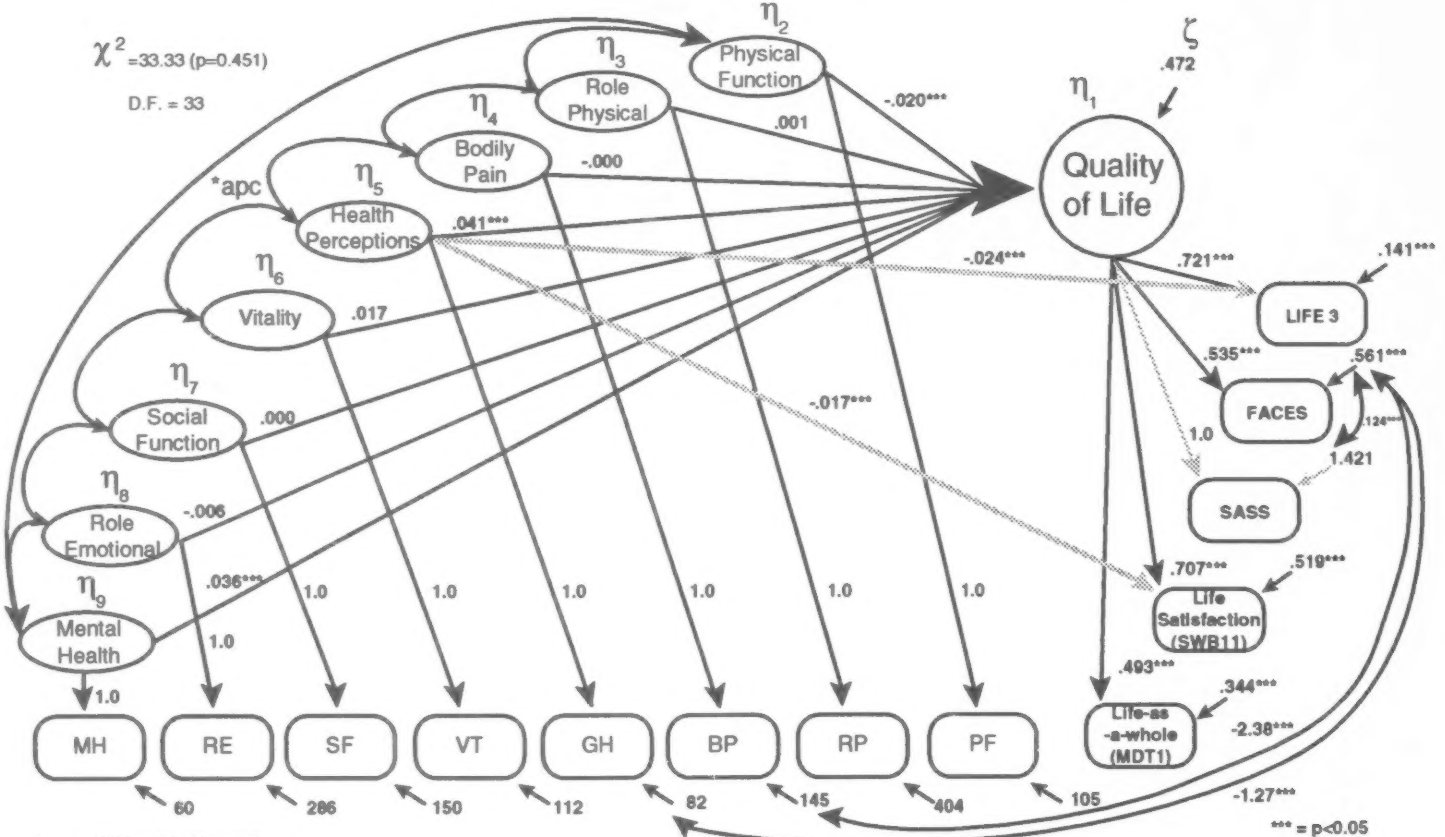
The largest subsequent modification index suggested removing the restriction and estimating the correlation between the measurement errors of the Faces Scale indicator of QOL and the indicator of the Bodily Pain concept. When this coefficient (-2.085) was freed and estimated, it was statistically significant (t=-2.506, p<0.05). With 35 degrees of freedom, the chi square was reduced to 44.08 (p=0.140) and the AGFI was 0.964.

Inspection of the modification indices suggested that freeing the coefficient between the General Health Perceptions concept and the QOL indicator Life Satisfaction (SWB11) would lead to the largest reduction in the chi square estimate. When this coefficient was estimated (-0.015) the T-value was statistically significant (t=-2.351, p<0.05). With 34 degrees of freedom, the chi square was acceptable at 37.91 (p=0.296) and the AGFI was 0.970. The SMC for the QOL concept increased to 0.649. Despite the adequate fit of the model, one more change was made.

A coefficient was freed to be estimated for the correlation between the measurement errors of the QOL indicator the Faces Scale and the indicator of the concept General Health Perceptions. The estimates of the structural coefficients for this final version of the model can be found in Figure 5.4 and Table 5.16. With 33 degrees of freedom, the chi square is 33.33 (p=0.451) and the AGFI is 0.974; the overall fit is very acceptable. The SMC for the QOL concept is 0.668. That is, the eight concepts of perceived health account for 67% of the variance in the QOL concept.

Two model revisions were attempted, somewhat less

Figure 5.4 Perceived Health and Quality of Life
Maximum Likelihood Estimates


χ^2 =33.33 (p=0.451)
D.F. = 33
*apc
η_1
Quality of Life
ζ
.472
η_2
Physical Function
η_3
Role Physical
η_4
Bodily Pain
η_5
Health Perceptions
η_6
Vitality
η_7
Social Function
η_8
Role Emotional
η_9
Mental Health
-.020***
.001
-.000
.041***
.017
.000
-.006
.036***
-.024***
-.017***
1.0
MH
RE
SF
VT
GH
BP
RP
PF
60
286
150
112
82
145
404
105
.721***
.535***
1.0
.707***
.493***
LIFE 3
FACES
SASS
Life Satisfaction (SWB11)
Life-as -a-whole (MDT1)
.141***
.561***
.124***
1.421
.519***
.344***
-2.38***
-1.27***

*apc = All Possible Correlations

*** = p<0.05

Table 5.16 Maximum Likelihood Estimates of the Relationship Between Perceived Health And Quality of Life

Lambda Coefficients

	QOL	PF	RP	BP	GH	VT	SF	RE	MH
MDT1	.493								
Faces	.535								
SASS	1.0*								
SWB11	.707				-.017				
Life 3	.721				-.024				
PF		1.0*							
RP			1.0*						
BP				1.0*					
GH					1.0*				
VT						1.0*			
SF							1.0*		
RE								1.0*	
MH									1.0*

Beta Coefficients

	QOL	PF	RP	BP	GH	VT	SF	RE	MH
QOL		-.020	.001	-.000	.041	.017	.000	-.006	.036

PSI

	QOL	PF	RP	BP	GH	VT	SF	RE	MH
QOL	.472								
PF		244.483							
RP		292.955	941.700						
BP		138.467	295.224	336.671					
GH		123.714	105.828	130.939	189.719				
VT		189.417	281.726	179.042	166.780	260.843			
SF		149.189	231.222	184.214	148.624	207.618	349.223		
RE		168.319	427.938	278.864	189.883	244.173	351.939	1144.281	
MH		96.015	152.189	117.764	127.761	171.001	202.729	339.927	239.900

(Theta Epsilon) Measurement Error Variance

	MDT1	Faces	SASS	SWB11	Life 3	PF	RP	BP	GH	VT	SF	RE	MH
MDT1	.344												
Faces		.561											
SASS		.124	1.421*										
SWB11				.519									
Life 3					.141								
PF						104.8*							
RP							403.6*						
BP		-2.379						144.9*					
GH		-1.275							81.8*				
VT										111.8*			
SF											149.6*		
RE												286.1*	
MH													60.0*

n=306 * = fixed coefficients

successfully, than the model displayed in Figure 5.4. First, the measurement error variance of all the health concept indicators was reduced to 20 percent of the observed variance. The chi square for this model was 35.03 (p=0.372) with 33 degrees of freedom. The effect of the Physical Functioning concept on the QOL concept in this model became statistically insignificant and the effect of the Role Functioning-Emotional concept on the QOL concept just reached statistical significance. The SMC of the QOL concept fell to 0.630 from 0.668 for the model in Figure 5.4.

Second, when the measurement error variance of all the health concept indicators was reduced to 10 percent of the observed variance, the chi square with 33 degrees of freedom was 36.95 (p=0.291). The SMC for the QOL concept dropped to 0.571 from 0.668 when 30% error variance had been specified. The effect of the Physical Functioning concept on the QOL concept in this model became statistically significant again and the effect of the Role Functioning-Emotional concept on QOL now was not. Together, these attempted revisions indicate that the unexpectedly negative effect of the Physical Functioning concept on QOL shown in Figure 5.4 ought to be treated as tentative and that there may also be a borderline effect from the Role Functioning-Emotional concept to QOL. The model in Figure 5.4 was chosen as the final model because it preserves more of the initial measurement specifications and involves fewer data-prompted model modifications.

Only three of the eight health concepts in Figure 5.4 exhibit a statistically significant effect on the QOL concept. The General Health Perceptions concept produces the strongest effect on QOL. The estimated beta coefficient is 0.041 which means that for every unit increase in the General Health Perceptions concept, the QOL concept is expected to increase by 0.041 units. The Mental Health concept exerts the second strongest effect on QOL (0.036). The effect of the Physical Functioning concept on QOL just reaches statistical significance but is unexpectedly negative (-0.020). Five of the health concepts (Role Functioning-Physical, Bodily Pain, Vitality, Social Functioning, and Role Functioning-Emotional) have no effect on the CABG surgical patients' assessment of their QOL.

The direct effects from the General Health Perceptions concept to the two QOL indicators, SWB11 and Life 3, are both statistically significant. The estimated lambda coefficient from the General Health Perceptions concept to Life 3 is slightly stronger (-0.024) than the effect to SWB11 (-0.017). Notably, both of these effects are negative. That is, for every unit increase in the General Health Perceptions concept, the Life 3 indicator is expected to decrease by -0.24 units.

Therefore, not only does the General Health Perceptions concept affect these two QOL indicators directly, but also, the concept influences them indirectly. However, these direct and indirect effects from the General Health Perceptions concept to Life 3 and SWB11 counteract each other. Consequently, the total effect of the General Health Perceptions concept on the two QOL indicators is zero.

More precisely, the direct effects of the General Health Perceptions concept on SWB11 is -0.017. The indirect effect through the QOL concept is the product of the beta coefficient from the General Health Perceptions concept (0.041) and the lambda coefficient from the QOL concept to SWB11 (0.707) which is 0.0289. Therefore, the total effect of the General Health Perceptions concept on SWB11 is the direct effect (-0.017) plus the indirect effect (0.0289) which is 0.0119 -- close to zero.

Similarly, the direct effect of the General Health Perceptions concept on Life 3 is -0.024. The indirect effect through the QOL concept is the product of the beta coefficient from the General Health Perceptions concept (0.041) and the lambda coefficient from the QOL concept to Life 3 (0.721) which is 0.029. Therefore, the total effect of the General Health Perceptions concept on Life 3 is the direct effect (-0.024) plus the indirect effect (0.029) which is 0.005 -- essentially zero.

Even though the direct effect of the General Health Perceptions concept on QOL is positive, the total effect of the concept on two of the QOL indicators, Life 3 and SWB11, is essential zero. This zero total effect on SWB11 and Life

3 and the accompanying positive effect on the QOL concept might reflect an inadequacy in these two QOL indicators compared to the MDT1, the SASS, and the Faces Scale. If these latter three QOL indicators are superior measures of QOL, they may be responsible for the effect of the General Health Perceptions concept on QOL. The negative direct effects from the General Health Perceptions concept to Life 3 and SWB11 are simply functioning to cancel the indirect effects through QOL.

The direct effects of the General Health Perceptions concept on two QOL indicators represents a threat to the construct validity of the QOL concept to an unknown degree. This may not be the correct model of the relationship between perceived health and QOL but the structural equation modeling evidence suggests that perceived QOL is affected by the dimensions of health differentially. Moreover, there is little evidence to support the claim that perceived health is a dimension of QOL rather than a predictor of QOL. Further, inspection of the standardized solution reveals that only two of the eight perceived health concepts (General Health Perceptions and Mental Health) have any real impact on QOL. There seems to be little evidence or justification to refer to the concepts of perceived health and perceived QOL interchangeably as is done so often in the literature.

Two major points require emphasis here. The first point of interest is the diversity of effects between the eight health concepts and QOL. The second, an extension of the first, is that some of the effects are positive, some are negative, and others are zero. Only the effects from the General Health Perceptions and the Mental Health concepts are positive and statistically significant. The effect from the Physical Functioning concept is negative and statistically significant. The effect from the Vitality concept is positive but statistically insignificant. The effects of the Role Functioning-Physical, Bodily Pain, Social Functioning, and Role Functioning-Emotional are essentially zero. This offers overwhelming evidence that a one factor, a two factor, or a three factor model would have failed to adequately portray the diversity of effects of perceived health on QOL shown in Figure 5.4.

Summary

This chapter describes the perceived health status of CABG surgical patients. Of the eight subscales of the SF-36 Health Survey, the lowest mean score is observed on the Role Functioning-Physical subscale and the highest mean score is seen on the Social Functioning subscale closely followed by the scores on the Mental Health subscale. Therefore, as one would expect, in the early postoperative period, patients are more limited in their daily physical activities than in their social activities or their perceived mental health status. Even so, the majority of patients reported feeling better physically compared to the previous week.

Aggressive attempts were made to determine the factor structure of the SF-36 subscales. Only a two factor solution was even interpretable but the statistical evidence lacked persuasion. This led to depicting the eight subscales as a profile of scores which provided continuity and form to the subsequent LISREL models.

A LISREL model was proposed to explain the relationship between perceived health, as measured by the eight subscales of the SF-36, and perceived QOL, as measured by the MDT1 item, the Faces Scale, the SASS, the SWB11 item, and the Life 3 Scale. With a few revisions, the model was consistent with the observed data covariance matrix. While not theoretically intolerable, some of these revisions were data driven. That is, the final model fit the data well even if with a few more data driven modifications than desirable. Some of the effects of the perceived health concepts on QOL were positive, some were negative, and others were essentially zero. Most disturbing was the need for direct effects from the General Health Perceptions concept to two of the QOL indicators. Even though these direct effects were counteracted by indirect effects through the intervening QOL concept, they represent a threat to the construct-related validity evidence of QOL.

It seems appropriate to reconsider the factor models discussed earlier in this chapter. Noting the direct effects of the SF-36 subscales on QOL one is led to ask - How would these effects on QOL have appeared if any of the factor models discussed early in the chapter had been accepted? A single factor model would have been confusing and misleading. If one effect from a "health factor" to QOL had been all that was permitted, only one effect estimate would have been available. No single estimate could possibly be consistent with the diverse set of effects observed in the final LISREL model of Figure 5.4 from the health concepts to QOL.

Would a two factor model have fared much better? With the Physical Functioning, the Role Functioning-Physical, the Bodily pain, and the General Health Perceptions subscales combined under a physical factor it would have been impossible to find any single effect magnitude that would have been consistent with the diverse effects in the final LISREL model. Similarly, if the Vitality, the Social Functioning, the Role Functioning-Emotional, and the Mental Health subscales had been combined under a mental health factor no single affect is likely to have represented a reasonable capture of all the individual effects observed in the final model. The decision to proceed beyond the information provided by the factor analyses to the more explicit LISREL model appears to have been wise.

VI. THE EFFECTS OF THE MULTIPLE DISCREPANCIES THEORY ON QUALITY OF LIFE

The conceptualization of QOL as a global and unidimensional construct measured by multiple indicators was tested in Chapter IV. Chapter V reveals that the effects of perceived health on QOL are diverse, depending on which dimension of health one is exploring. This chapter explores another attempt at accounting for the variance in the QOL concept. The Multiple Discrepancies Theory (MDT), substantively well developed, offers considerable promise for explaining how CABG surgical patients evaluate the quality of their lives.

This chapter presents the findings of the evaluation of a LISREL model of the effects of the MDT on perceived QOL. A discussion of the descriptive statistics of the MDT variables is followed by the evaluation of the adequacy with which the MDT accounts for QOL. Finally, the revisions which were necessary to obtain an adequately fitting structural equation model are described.

The MDT posits that overall life satisfaction and happiness are functions of seven perceived discrepancies. The focus of the present study is to empirically test the perceptual core of the MDT (see Appendix A). The two hypotheses of the MDT tested in this study include:

H1: Reported overall life satisfaction is a positive linear function of perceived discrepancies between what one wants and what one has (self/wants), between what others have and what one has (self/others), between what one deserves and what one has now (self/deserves), between what one needs and what one has (self/needs), between what one expected to have 3 years ago and what one has now (self/expected), between what one expects to have 5 years in the future and what one has now (self/expects), and between the best one has had in the past and what one has now (self/best).

H2: The perceived discrepancy between what one has and wants (self/wants) is a mediating variable between all other perceived discrepancies and overall life satisfaction or perceived QOL.

A seven item questionnaire, an abbreviated version of the original instrument designed by Michalos (1980; 1985; 1991a), was used to assess the various discrepancies of overall life satisfaction. An eighth MDT item measuring satisfaction with life-as-a-whole (MDT1), discussed briefly here and in more detail in Chapter III, was selected as a global measure of perceived QOL; the remaining seven items were selected as predictors of QOL. A description of this instrument appears in Chapter III and Appendix I. The seven items have a 7-point labeled scale which runs from terrible to delightful. In contrast to the original questionnaire, the respondents in this study were not given the option of choosing no opinion.

Descriptive Statistics

Table 6.1 to Table 6.3 provide the descriptive statistics for the eight MDT variables. The mean perceived gap between what CABG surgical patients' have and want is the smallest of all the gaps (5.337) and has the most negatively skewed distribution. Michalos (1986) also found the self/wants gap was the smallest for a group of Canadian seniors. The second smallest gap, the perceived discrepancy between what one has and thinks others of the same age and sex have (self/others), has a mean score of 4.588. The largest perceived gap is the gap between what one has and expects to have in 5 years. The median age of the CABG surgical patients is 63 years and Michalos (1986) has suggested that, often, at such an age, few unmet expectations remain. However, Michalos (1985) found that, even in a group of 700 undergraduate Canadian University students, the self/expects discrepancy variable was the fourth largest.

The mean score for the life-as-a-whole (MDT1) item is 5.095; a score almost identical to that found for residents of a northern Ontario community (Michalos, 1983) and for Canadian university students (Michalos, 1985) but lower than the score for 357 university clerical staff (5.45).

Table 6.1

Descriptive Statistics of Multiple Discrepancies Theory Items

Statistic	**Life as Whole**	**Self/Wants**	**Self/Others**
Possible range of item	6	6	6
Observed Range	5	6	6
Mean	5.095	5.337	4.588
Median	5.000	5.500	4.000
Mode	5.000	6.000	4.000
Standard Deviation	.830	.962	1.093
Standard Error	.047	.055	.062
Skewness	-.421	-.918	-.053

n=306

Table 6.2

Descriptive Statistics of Multiple Discrepancies Theory Items

Statistic	**Self/Deserves**	**Self/Needs**	**Self/Expected**
Possible range Of item	6	6	6
Observed Range	6	6	6
Mean	4.176	4.065	3.990
Median	4.000	4.000	4.000
Mode	4.000	4.000	4.000
Standard Deviation	1.090	1.117	1.219
Standard Error	.062	.064	.070
Skewness	-.050	.311	-.003

n=306

Table 6.3

Descriptive Statistics Of Multiple Discrepancies Theory Items

Statistic	**Self/Expects**	**Self/Best**
Possible range Of item	6	6
Observed Range	6	6
Mean	3.425	3.513
Median	3.000	3.000
Mode	3.000	3.000
Standard Deviation	.877	1.252
Standard Error	.050	.072
Skewness	.231	.106

n=306

The self/deserves, self/needs, and the self/expected discrepancy variables have very similar means and standard deviations (see Table 6.2). However, of the three, the self/deserves discrepancy demonstrates the greatest negative skew and the self/needs discrepancy the greatest positive skew. The self/expects discrepancy variable has the lowest mean value of all the variables (see Table 6.3). Michalos (1986), who also found that this variable displayed the lowest mean score, offers a reasonable explanation.

Michalos points out that the response categories for the eight questions run from extremely less (1) through about the same (4) to extremely more (7). Notably, seven of the eight items run from relatively unattractive states (1) to relatively attractive states (7). For the self/expects item, however, the respondent must select a low score (1), that is, extremely less, in order to indicate an attractive state reflecting hope for a better future. Michalos reversed the polarity of the item before data analysis to deal with this issue. The item was unaltered in this study because the ambiguity of this item was obvious the first time it was administered. The investigator dispelled this ambiguity for the respondent prior to a response being offered.

Correlations Among The Multiple Discrepancies Theory Items

The correlations among the eight MDT variables appear in Table 6.4. The highest correlation in the matrix is between the self/deserves and the self/needs discrepancy items (r=0.63). The lowest correlation in the matrix is between the self/others discrepancy and the self/expects discrepancy (r=0.0155). In general, the lowest correlations involve the self/expects discrepancy variable, the variable for which a lower scale score reflects hope for a positive future. The correlation between the self/best and self/expects is weakly negative (r=-0.0260). The remaining correlations ranged from a low of 0.05 to a high of 0.51.

Table 6.4

Correlation Matrix of Multiple Discrepancies Theory Items

	MDT1	**MDT2**	**MDT3**	**MDT4**	**MDT5**	**MDT6**	**MDT7**	**MDT8**
MDT1	1.00	.5140	.4696	.4053	.4104	.3476	.0256	.4008
MDT2		1.00	.4473	.4715	.4492	.2964	.1602	.3487
MDT3			1.00	.4768	.4599	.1816	.0155	.2675
MDT4				1.00	.6312	.2506	.1545	.3177
MDT5					1.00	.2172	.1522	.2923
MDT6						1.00	.0499	.3921
MDT7							1.00	-.0260
MDT8								1.00

n=306

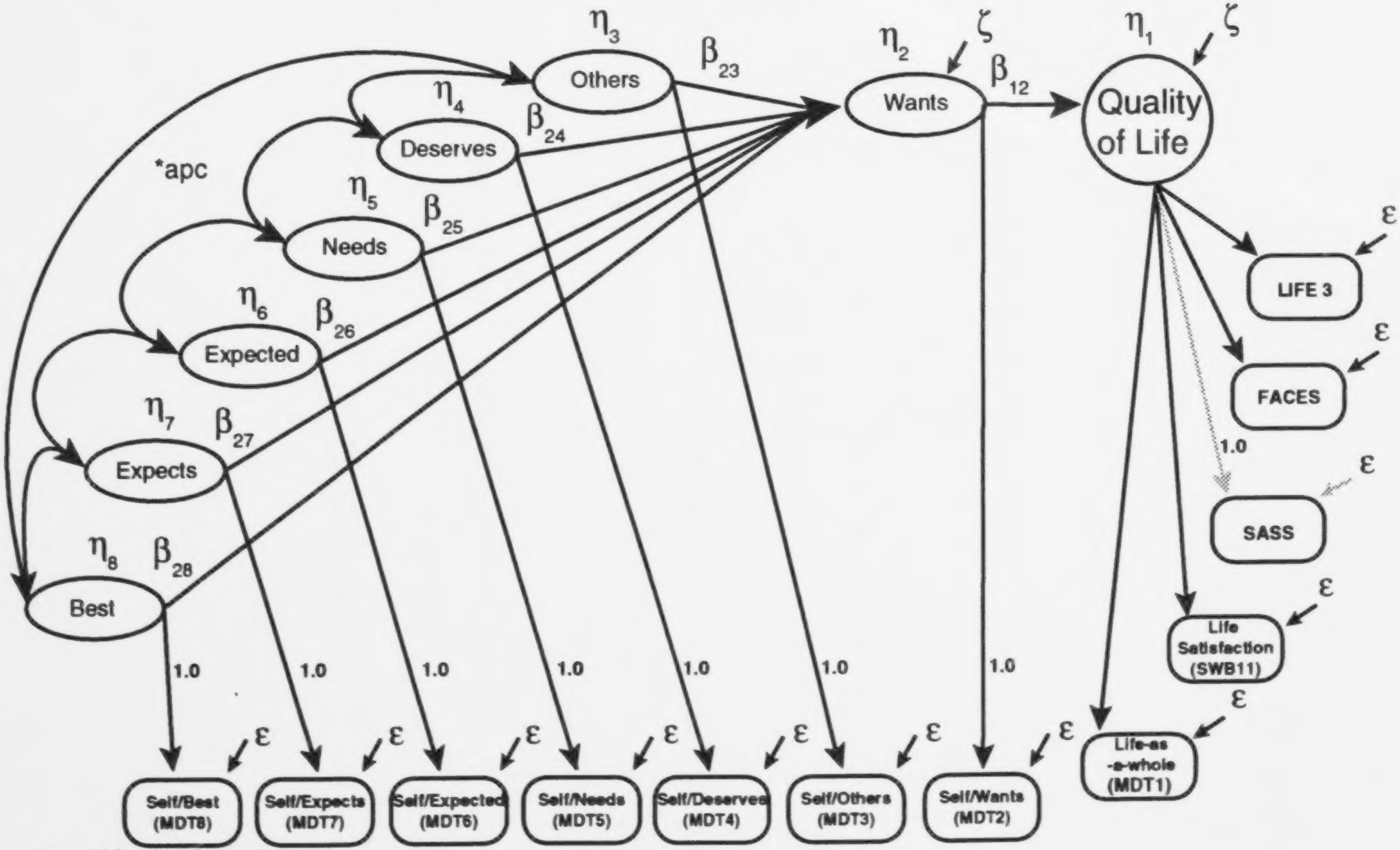
MDT1 = Life as a whole
MDT2 = Self/want
MDT3 = Self/Others
MDT4 = Self/Deserves
MDT5 = Self/Needs
MDT6 = Self/Expected
MDT7 = Self/Expects
MDT8 = Self/Previous Best

LISREL Model of The Effects Of The Multiple Discrepancies Theory On Quality of Life

The model in Figure 6.1 illustrates the first attempt to examine the effects of the MDT on QOL. The model is similar to that outlined by Michalos (1991a, p. 65) with two major exceptions. The first involves the conceptualization of QOL. While the measurement of QOL includes the life-as-a-whole item (MDT1) of the MDT, the QOL concept is measured by four additional indicators. These measures are discussed in Chapters III and IV. The second difference between the model in Figure 6.1 and that of the perceptual core of the MDT is that demographic variables, or what Michalos (1991) refers to as "conditioners", are excluded from this model. Demographic variables were not used to predict perceived QOL because previous research consistently demonstrates that they have little predictive power.

The concepts in the model shown in Figure 6.1 include: perceived quality of life (QOL), self/wants (WANTS), self/others (OTHERS), self/deserves (DESERVES), self/needs (NEEDS), self/expected (EXPECTED), self/expects (EXPECTS) and self/best (BEST). For brevity, these concepts will, hence forth, be referred to as QOL, WANTS, OTHERS, DESERVES, NEEDS, EXPECTED, EXPECTS and BEST, respectively. Each of the MDT concepts has a single indicator, which is provided the same name as the concept but are the actual responses of the study participants.

Figure 6.1 The Effects of The Multiple Discrepancies Theory on Quality of Life



η3
Others
β23
η2
ζ
Wants
β12
η1
ζ
Quality of Life
η4
Deserves
β24
*apc
η5
Needs
β25
η6
Expected
β26
η7
Expects
β27
η8
Best
β28
ε
LIFE 3
ε
FACES
1.0
ε
SASS
ε
Life Satisfaction (SWB11)
ε
Life-as -a-whole (MDT1)
1.0
1.0
1.0
1.0
1.0
1.0
1.0
ε
ε
ε
ε
ε
ε
ε
Self/Best (MDT8)
Self/Expects (MDT7)
Self/Expected (MDT6)
Self/Needs (MDT5)
Self/Deserves (MDT4)
Self/Others (MDT3)
Self/Wants (MDT2)

*apc = All Possible Correlations

Each MDT concept is scaled to the corresponding responses on the questionnaire item related to that concept by fixing the lambda coefficient between them at 1.0. The measurement error variance for the observed variables are fixed at non-zero values (see Table 6.5). Familiarity with the study methodology, observations of respondent behavior, and the degree of confidence in the quality of the indicator provided the information about measurement quality which was then incorporated into the model specifications.

Even though the majority of the MDT questions were easily comprehended, perceived discrepancies are probably not contemplated in the course of daily life. That is, having the CABG surgical patients respond to questions about QOL and perceived discrepancies in an interview situation is a contrived and artificial environment and measurement error is bound to be introduced in such a situation. Like all the indicators of perceived QOL, the life-as-a-whole item (MDT1) is assigned a measurement error variance of 50% of the total observed variance. Being the first of the MDT questionnaire items and immediately following a health survey, a shift in mind set might be required in responding.

Table 6.5 Measurement Error Variance

Indicator	Variance	Assigned Error	Error Variance
Multiple Discrepancies Theory Measures			
Self/Wants	0.926	40%	0.3704
Self/Others	1.194	35%	0.4179
Self/Deserves	1.188	35%	0.4158
Self/Needs	1.248	35%	0.4368
Self/Expected	1.485	40%	0.594
Self/Expects	0.770	50%	0.385
Self/Best	1.569	40%	0.6276
Quality of Life Measures			
MDT1	0.689	50%	0.3445*
FACES	0.968	50%	0.484*
SASS	2.842	50%	1.421
SWB11	1.008	50%	0.504*
LIFE 3	0.583	50%	0.2915*

* - coefficient free to be estimated

The items which measure the concepts WANTS, EXPECTED, and BEST are assigned 40% measurement error variance. Three MDT items are assigned a measurement error variance of 35% of the total observed variance (self/others, self/deserves, and self/needs). The discrepancy item measuring the concept EXPECTS was assigned 50% error variance because the question requires a reversed polarity response compared to the other 7 items. That is, to indicate optimism about the future the respondent must select a negative response category such as extremely less, much less, or less. Some respondents found this confusing and many simply chose about the same, the neutral position, in response to the item. Several respondents suggested an improved wording of "Consider your life as a whole. Do you expect life to offer you more in five years than it does now, much more, etc.?"

The QOL concept has five indicators as discussed in detail in Chapters III and IV. They include: the life-as-a-whole (MDT1) item of the MDT, the Faces Scale, the Self-Anchoring Striving Scale (SASS), the Life Satisfaction item (SWB11) of the Index of Well-Being (IWB) Scale, and the Life 3 Scale. The QOL concept is scaled to the SASS indicator by inserting a fixed lambda coefficient between them at a value of 1.0. The SASS item is assigned a fixed proportion of measurement error variance at 50% of the total observed variance while the remaining QOL indicators are free to be estimated with starting values of 50% of the total observed variance of the variables. The justification of the measurement quality of the concept of QOL is discussed in chapter IV.

The six arrows from the endogenous concepts WANTS, DESERVES, NEEDS, EXPECTED, EXPECTS, AND BEST leading to the second endogenous concept, WANTS, represents the theoretical assertions that all effects from the six discrepancies concepts to the QOL concept are mediated through the concept WANTS or what is referred to as the aspiration/achievement gap. This concept, the aspiration/achievement gap, proves to be a very important link in the MDT theory. Its placement as an intervening variable between QOL and all other concepts in the model warrants special attention both in this study and in future research.

The WANTS concept is substantively and structurally distinctive. First, it creates parsimony. The model is composed of constraints - there can be no effect from the six background multiple discrepancies concepts to QOL but through the WANTS concept. The position of the concept in the model postulates a common mechanism of how the prior integration or combination of multiple discrepancies are funneled through the concept to effect the assessment of overall QOL. Second, it implies that in order to understand how QOL is determined, one need only go back as far as the assessment of the aspiration/achievement gap because all the information is filtered through the WANTS concept.

Maximum Likelihood Estimates

The maximum likelihood estimates for the model of the effects of the MDT on QOL are found in Table 6.6 and are illustrated in Figure 6.2. This model is evaluated in detail before a discussion of the options explored in providing a model which fit this data set more adequately. The estimated coefficients with statistically significant T-values are indicated in Table 6.6.

The beta coefficient between the concept WANTS, or what Michalos (1991a) calls the aspiration/achievement gap, and the QOL concept is highly significant (beta standardized = 0.900, t=11.09, p<0.01). That is, each unit increase in the

Table 6.6 LISREL Maximum likelihood Estimates

Lambda Coefficients

	QOL	WANTS	OTHERS	DESERVES	NEEDS	EXPECTED	EXPECTS	BEST
MDT1	0.501*							
FACES	0.525*							
SASS	1.00							
SWB11	0.561*							
LIFE 3	0.496*							
WANTS		1.0						
OTHERS			1.0					
DESERVES				1.0				
NEEDS					1.0			
EXPECTED						1.0		
EXPECTS							1.0	
BEST								1.0

Beta Coefficients

	QOL	WANTS	OTHERS	DESERVES	NEEDS	EXPECTED	EXPECTS	BEST
QOL	0.0	1.514*	0.0	0.0	0.0	0.0	0.0	0.0
WANTS	0.0	0.0	0.405*	0.335	-0.208	0.121	0.138	0.199
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DESERVES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEEDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Psi Variance

	QOL	WANTS	OTHERS	DESERVES	NEEDS	EXPECTED	EXPECTS	BEST
QOL	0.284							
WANTS	0.0	0.117						
OTHERS	0.0	0.0	0.776					
DESERVES	0.0	0.0	0.568	0.773				
NEEDS	0.0	0.0	0.561	0.769	0.811			
EXPECTED	0.0	0.0	0.242	0.333	0.296	0.891		
EXPECTS	0.0	0.0	0.015	0.148	0.149	0.053	0.385	
BEST	0.0	0.0	0.366	0.434	0.409	0.599	-0.028	0.941

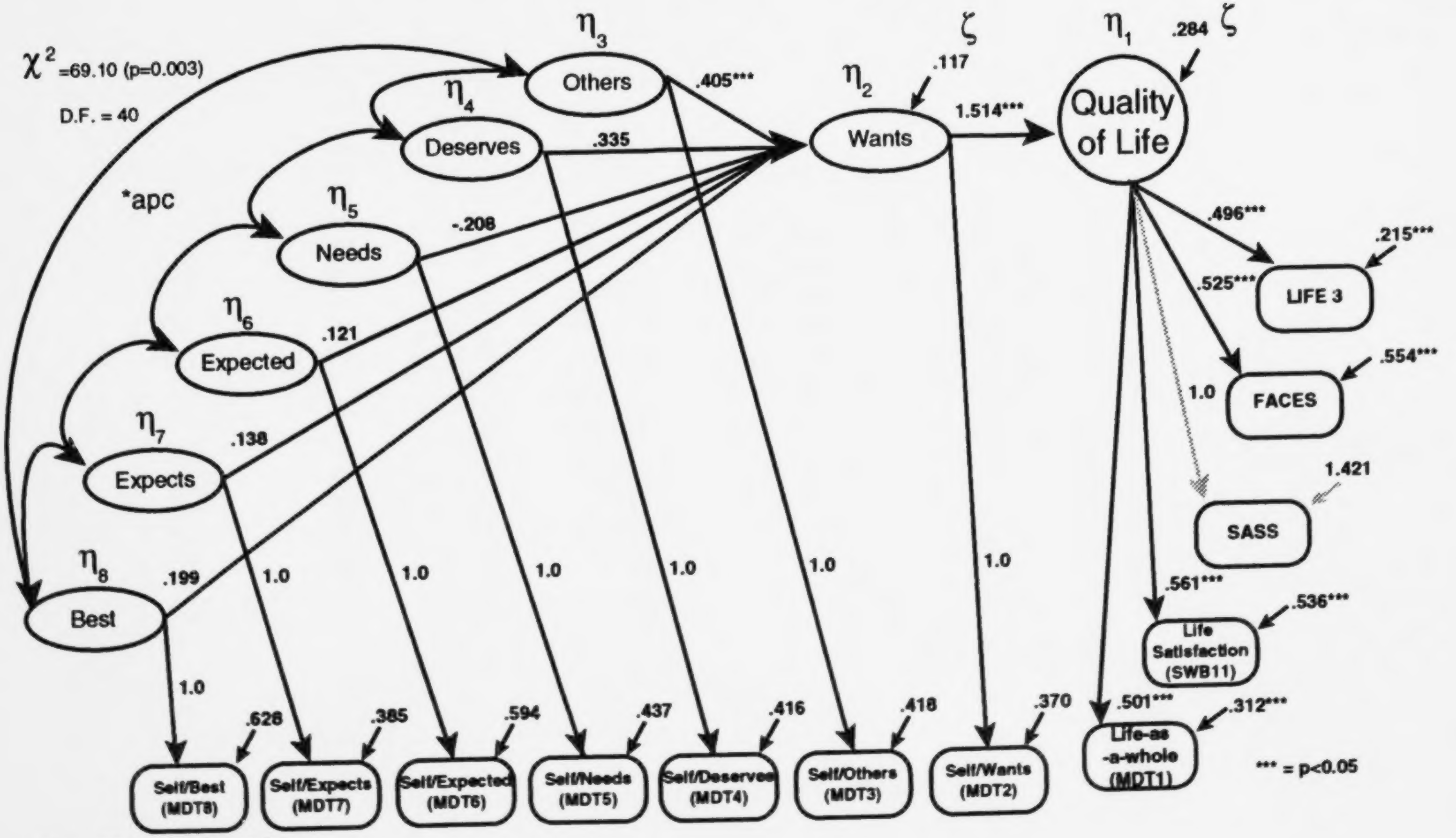
Theta Epsilon (Measurement Error Variance)

	MDT1	FACES	SASS	SWB11	LIFE3	MDT2	MDT3	MDT4	MDT5	MDT6	MDT7	MDT8
MDT1	0.312*											
FACES		0.554*										
SASS			1.421									
SWB11				0.536*								
LIFE3					0.215*							
WANTS						0.370						
OTHERS							0.418					
DESERVES								0.416				
NEEDS									0.437			
EXPECTED										0.594		
EXPECTS											0.385	
BEST												0.628

n=306

*=p<0.05

Figure 6.2 The Effects of The Multiple Discrepancies Theory on Quality of Life: Maximum Likelihood Estimates


χ² =69.10 (p=0.003)
D.F. = 40
*apc
η3
Others
.405***
η4
Deserves
.335
η5
Needs
-.208
η6
Expected
.121
η7
Expects
.138
η8
Best
.199
ζ
.117
η2
Wants
1.514***
η1
.284
ζ
Quality of Life
.496***
.215***
.525***
LIFE 3
1.0
FACES
.554***
1.421
SASS
.561***
.536***
Life Satisfaction (SWB11)
.501***
.312***
Life-as -a-whole (MDT1)
*** = p<0.05
1.0
1.0
1.0
1.0
1.0
1.0
1.0
1.0
.628
.385
.594
.437
.416
.418
.370
Self/Best (MDT8)
Self/Expects (MDT7)
Self/Expected (MDT6)
Self/Needs (MDT5)
Self/Deserves (MDT4)
Self/Others (MDT3)
Self/Wants (MDT2)

*apc = All Possible Correlations

respondents' assessment of the discrepancy between what they have and what they want increases their QOL assessment by 1.514 units. This effect in the model proved, throughout the modeling history of the effects of the MDT concepts on QOL, to be a consistently important causal link in the model.

The second, and only other, statistically significant beta coefficient (0.405) is the effect of the OTHERS concept on the WANTS concept ($t=3.376$, $p<0.05$). An unit increase in the concept OTHERS is expected to be accompanied by a 0.405 unit increase in the WANTS concept. The remaining MDT concepts, except for the concept NEEDS, positively influence the QOL concept but fail to reach statistical significance. Using multiple regression analyses, Michalos (1986) similarly found that social comparisons (OTHERS) had the greatest direct effect on the self/wants gap. In contrast to the present study, he also found that the self/best discrepancy also had a significant influence on the self/wants variable ($p< 0.001$).

The error variance in the prediction of the endogenous concepts QOL and WANTS is contained in the psi matrix. The error variance corresponding to the prediction of QOL is 0.284, which is about 19% of the variance in this concept. Therefore, most (81%) of the variance in this concept comes from the single most important diagrammed causal MDT variable -- the WANTS concept. The WANTS concept carries all the integrated effects of the six other MDT concepts. The prediction of the concept WANTS is also very strong. The error variance in WANTS makes up 22% of the variance in this concept and thus 78% of the variance is explained by the model, primarily by the concept OTHERS.

Joreskog (1993) describes a chi square as a badness-of-fit measure because a small and insignificant chi square value indicates a better fitting model and a large chi square accompanies a bad fitting model. For the model in Figure 6.2 LISREL reports a chi square of 69.10 with 40 degrees of freedom, which has probability 0.003. Since the probability of 0.003 exceeds the usual 0.05 criteria, the conclusion is to reject that the differences between the model-implied covariance matrix and the observed covariance matrix are small enough to be sampling fluctuation.

Examining the residuals is useful in searching for why the model in Figure 6.2 failed. Standardized residuals are helpful clues for locating the largest residuals and their patterns. The largest standardized residual (-2.281) is between the concept EXPECTS and the QOL indicator the Faces Scale. Further, a pattern of residuals involving the concept BEST suggests that allowing effects from this concept to a number of the QOL indicators might improve the fit of the model. The values of these residuals, while not large, do point out discrepancies between the observed covariances and the model-implied covariances. The modification indices, similarly, suggest that inserting a coefficient to be estimated between the concept EXPECTS and the Faces Scale would reduce the chi square by a value of 10.02.

Models containing many similar concepts or many measurement error covariances are potentially troublesome. If two concepts are nearly identical, exceptionally precise and error-free data may be required to attribute unique effects to these concepts. Correlations between coefficient estimates exceeding about 0.90 may signify identification problems. A correlation near 1.0 indicates that the value estimated for one coefficient almost perfectly predicts the value estimated for the other. That is, there exists a collinearity between the estimates of the two coefficients. Examination of the correlation of the estimates in the LISREL output reveals a very high correlation (-0.992) between the estimates of the effects of both the concepts DESERVES and NEEDS on the concept WANTS. The correlation between these concepts is 0.971, suggesting a collinearity problem.

The next few pages present several unacceptable attempts to resolve this problem. They include: creating a new concept, adding an indicator to the QOL concept, and allowing correlated measurement error. These attempts lead ultimately to an acceptable solution of reducing the measurement error variance of the indicators of the collinear concepts.

LISREL Model Revisions

Creating A New Concept

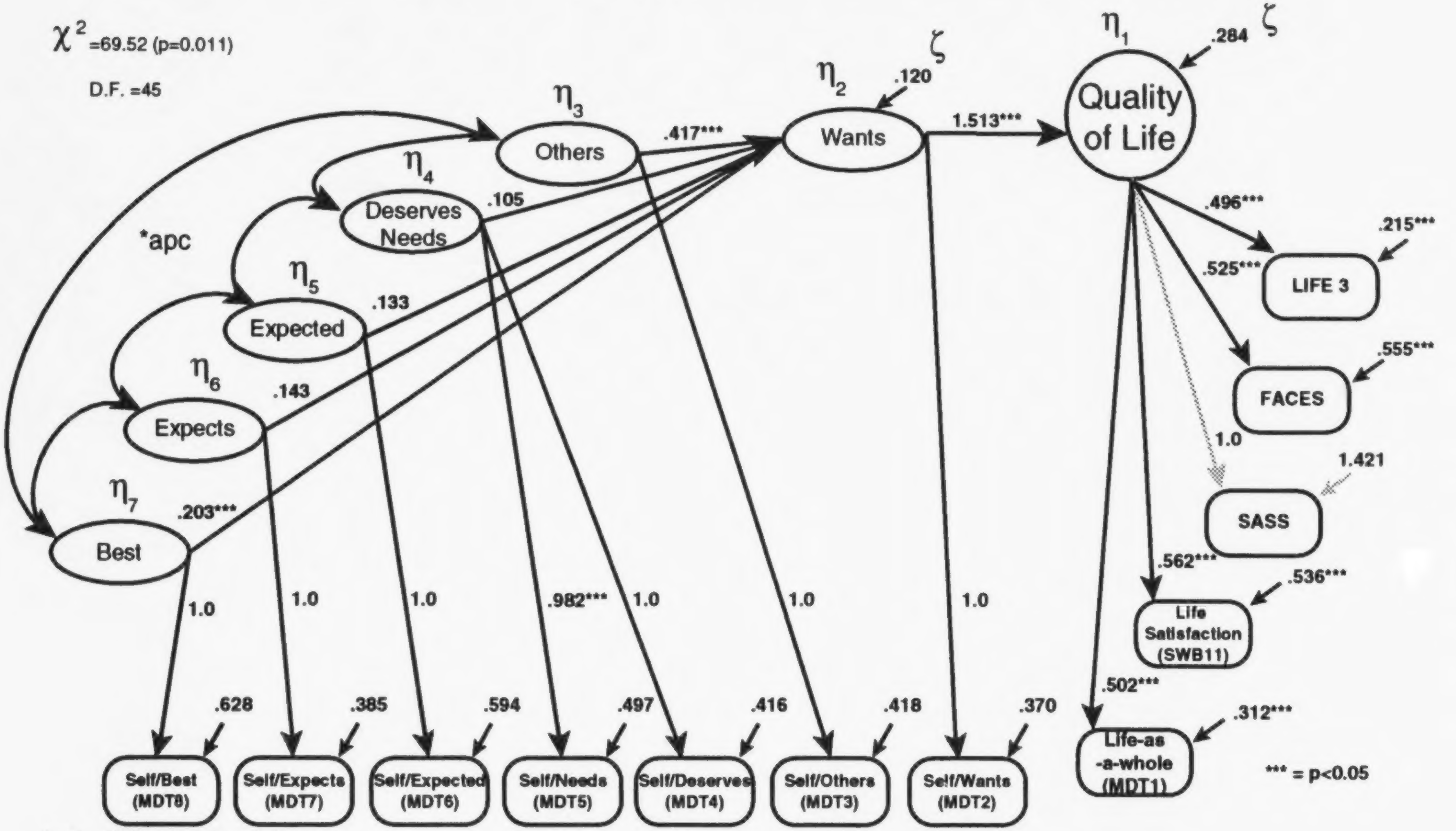
Concerned with the high correlation between the concepts DESERVES and NEEDS, a model was constructed with a new concept which represents both these concepts (see Figure 6.3). The new concept now has two indicators. The new concept (DESERVES/NEEDS) is scaled to the DESERVES indicator by placing a fixed lambda coefficient at a value of 1.0 between them. The NEEDS indicator is free to be estimated.

The overall fit of this model is about the same as the original model as demonstrated by a chi square of 69.52 (p=.011) with 45 degrees of freedom. While the collinearity problem was eliminated, such a drastic theoretical change in the MDT portion of the model was deemed unacceptable. Combining the two concepts changed the theory far too substantially with too little benefit. This model was eventually abandoned.

Self/Best As An Indicator Of QOL

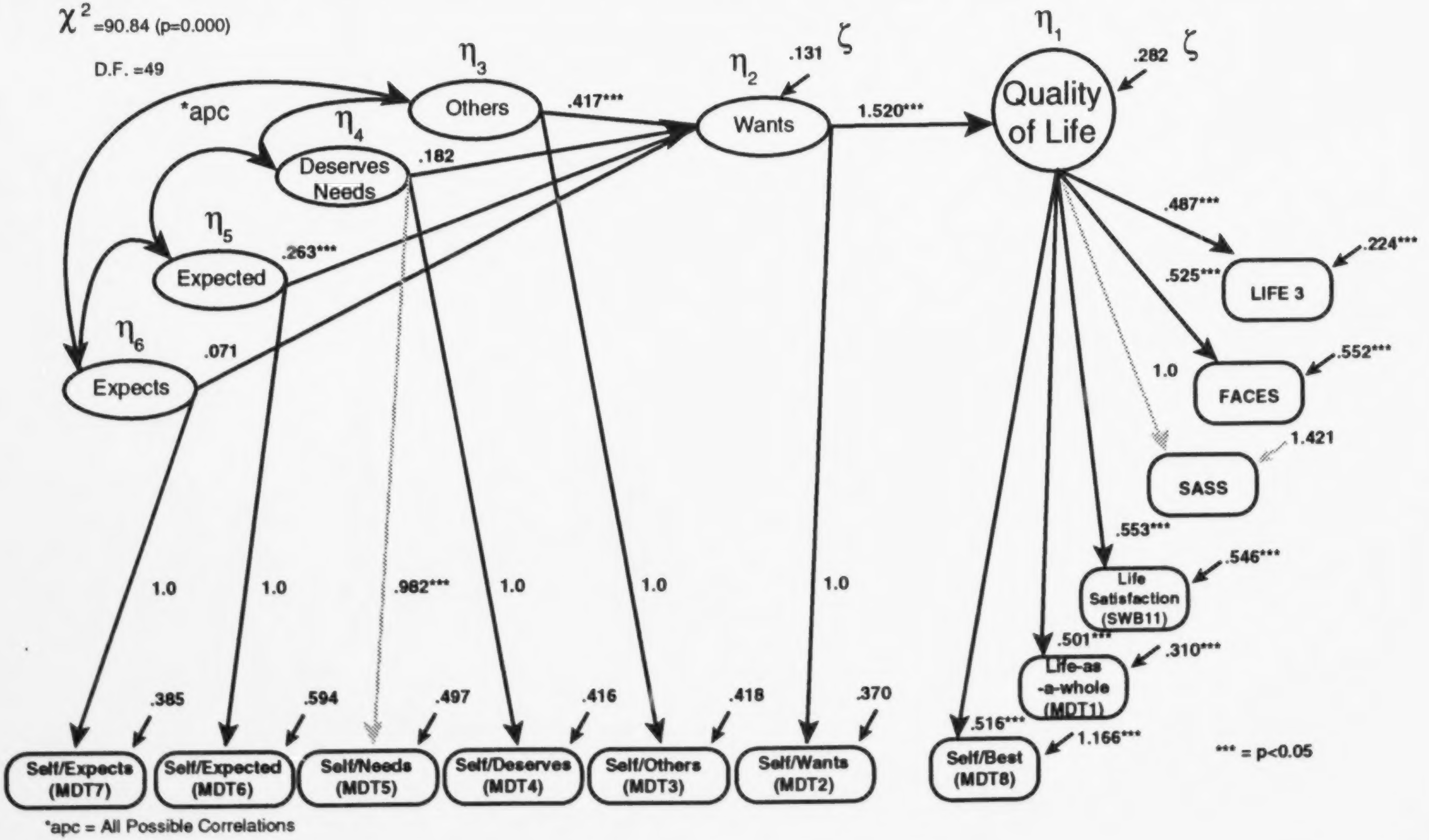
The next theoretically plausible modification involves eliminating the concept BEST and placing the observed indicator self/best as a sixth indicator of QOL (see Figure 6.4). The justification for this model revision is that the LISREL diagnostics (residuals and modification indices) suggested a need for an effect from the BEST concept directly to most of the QOL indicators. That is, the self/best indicator was behaving as an indicator of QOL rather than as

Figure 6.3 The Effects of The Multiple Discrepancies Theory on Quality of Life (New Concept): Maximum Likelihood Estimates


χ^2 =69.52 (p=0.011)
D.F. =45
η_1
.284
ζ
Quality of Life
η_2
.120
ζ
Wants
1.513***
η_3
Others
.417***
η_4
Deserves Needs
.105
η_5
Expected
.133
η_6
Expects
.143
η_7
Best
.203***
*apc
.496***
.215***
.525***
LIFE 3
.555***
FACES
1.0
1.421
SASS
.562***
.536***
Life Satisfaction (SWB11)
.502***
.312***
Life-as -a-whole (MDT1)
*** = p<0.05
1.0
1.0
1.0
.982***
1.0
1.0
1.0
.628
.385
.594
.497
.416
.418
.370
Self/Best (MDT8)
Self/Expects (MDT7)
Self/Expected (MDT6)
Self/Needs (MDT5)
Self/Deserves (MDT4)
Self/Others (MDT3)
Self/Wants (MDT2)

*apc = All Possible Correlations

Figure 6.4 The Effects of The Multiple Discrepancies Theory on Quality of Life (Self/Best-QOL Indicator): Maximum Likelihood Estimates


χ^2 =90.84 (p=0.000)
D.F. =49
*apc
η_3
Others
.417***
η_2
.131
ζ
Wants
1.520***
η_1
.282
ζ
Quality of Life
η_4
Deserves Needs
.182
η_5
Expected
.263***
η_6
Expects
.071
.487***
LIFE 3
.224***
.525***
FACES
.552***
1.0
SASS
1.421
.553***
Life Satisfaction (SWB11)
.546***
.501***
Life-as -a-whole (MDT1)
.310***
.516***
Self/Best (MDT8)
1.166***
*** = p<0.05
1.0
1.0
.982***
1.0
1.0
1.0
.385
.594
.497
.416
.418
.370
Self/Expects (MDT7)
Self/Expected (MDT6)
Self/Needs (MDT5)
Self/Deserves (MDT4)
Self/Others (MDT3)
Self/Wants (MDT2)
*apc = All Possible Correlations

an indicator of the concept BEST. Since the referent on both the self/best item and the SASS is the best life one can imagine or the best previous experience, this revision is theoretically acceptable.

The outcome of this model revision is, however, unacceptable. With 49 degrees of freedom the chi square is 90.84 ($p=0.000$). Even though the lambda coefficient from QOL to the self/best indicator is statistically significant ($t=8.328$, $p<0.05$) the squared multiple correlation (SMC) for this indicator is very low (.257). The effects (beta coefficients) from the concepts OTHERS and EXPECTED on the QOL concept are statistically significant. However, the maximum modification index is 17.45 for a free beta coefficient from the concept EXPECTED to the self/best indicator. Such a change to the MDT is theoretically incomprehensible and this model was relinquished.

Allowing Correlated Measurement Error Variance

Several correlated measurement errors were also examined. They included the correlation of the measurement errors between (1) the SWB11 item and the Life 3 Scale, 2) the MDT1 item and the SASS, and 3) the Faces Scale and the SASS. Only the correlation between the measurement error of the Faces Scale and the SASS was significant and remained so in all subsequent model revisions.

Reduced Measurement Error Variance

A theoretically more acceptable solution to the collinearity problem between the concepts DESERVES and NEEDS involves reducing the measurement error variance of the indicators self/deserves and self/needs to 25% from 35%. The original assessment of the gap between the concepts DESERVES and NEEDS and their respective indicators was overly pessimistic. It is contradictory, given the data variances and covariances, to have two separate concepts and as much measurement error variance as was originally specified.

The high covariance between the indicators of these two concepts implies too strong a correlation between the concepts. The original measurement error variance specification was too conservative and implied a loose conceptualization of the two concepts. Therefore, given that to maintain the integrity of the MDT theory the model must have both the concept DESERVES and the concept NEEDS, it was necessary to reduce the measurement error variance of their indicators. Assigning less measurement error variance to the indicators reduces the unacceptably high correlation between the concepts DESERVES and NEEDS. This decreased measurement error variance was retained throughout all remaining model revisions.

In subsequent model revisions every attempt was made to remain faithful to the original model of the effects of the MDT on QOL. Even though a number of beta coefficients of the original model (see Figure 6.2) are statistically insignificant, eliminating them would defy the theory. Using the insignificance of several coefficients as justification for altering the model by deleting these coefficients would compromise the model chi square test because it would amount to incorporating data-prompted model revisions. Therefore, two general approaches for model revision were attempted.

One strategy involves inserting additional beta coefficients between concepts to be estimated and the other strategy involves inserting additional lambda coefficients between concepts and indicators in the model to be estimated. Inserting lambda coefficients, particularly to the QOL indicators, is theoretically less acceptable than inserting beta coefficients because the implication is that the indicators of QOL are influenced by concepts other than QOL. That is, the construct validity of the QOL concept is threatened. Adding beta coefficients is theoretically more palatable because it simply suggests that the concept QOL is influenced directly by various concepts of the MDT in addition to the influence mediated by the concept WANTS. Therefore, the first strategy, adding more beta coefficients to be estimated, was implemented before the second strategy of adding lambda coefficients to be estimated.

Additional Beta Coefficients

The first theoretically plausible model change involves freeing the beta coefficient between the concept BEST and the concept QOL. A direct effect from BEST to QOL is theoretically possible. When estimated, this coefficient is statistically significant (t=2.115, p<0.05). With 38 degrees of freedom the chi square is 61.17 (p=0.010). This minimal decrease in the chi square is not surprising considering that the modification indices for the original model suggested a need to free several lambda coefficients rather than beta coefficients. However, as noted previously, implementing all theoretically-driven model revisions preceded and predominated any data-prompted changes.

The second theoretically-driven model revision involves freeing the beta coefficient to be estimated between the concept EXPECTS and the concept QOL which is statistically significant (t=-2.054, p<0.05). However, the previously added beta coefficient from the concept BEST to QOL now becomes statistically insignificant. With 37 degrees of freedom the chi square is 56.31 (p=0.022). The LISREL diagnostics once again suggest freeing several lambda coefficients. There is no theoretical justification for freeing additional beta coefficients. Therefore, the remaining model revisions comprise freeing lambda coefficients. Acknowledging the theoretically alteration of the original MDT, these data-driven modifications are pursued only to permit a better fit between the model and this particular data set.

Additional Lambda Coefficients

The first data-prompted model revision consists of adding a lambda coefficient to be estimated between the concept BEST and the QOL indicator the Life 3 Scale. The T-value for this estimated lambda coefficient is statistically significant ($t=-2.917$, $p<0.05$). Throughout all subsequent model revisions, freeing this coefficient was consistently essential to an adequate fit of the model to this data set. However, the negative direction of the estimate is unexpected and problematic. The negative coefficient suggests that the Life 3 Scale is behaving inconsistent with the other QOL indicators in the presence of this external directed effect from BEST. With 36 degrees of freedom the chi square of this revised model is 44.61 ($p=0.154$).

The second lambda coefficient freed for estimation is between the concept BEST and the QOL indicator SWB11. The estimate of this coefficient is statistically significant ($t=-2.934$, $p<0.05$). The overall fit of the model is improved with a chi square of 33.69 ($p=0.531$) with 35 degrees of freedom. Interestingly, the beta coefficient between the concept BEST and the concept QOL reaches statistical significance again.

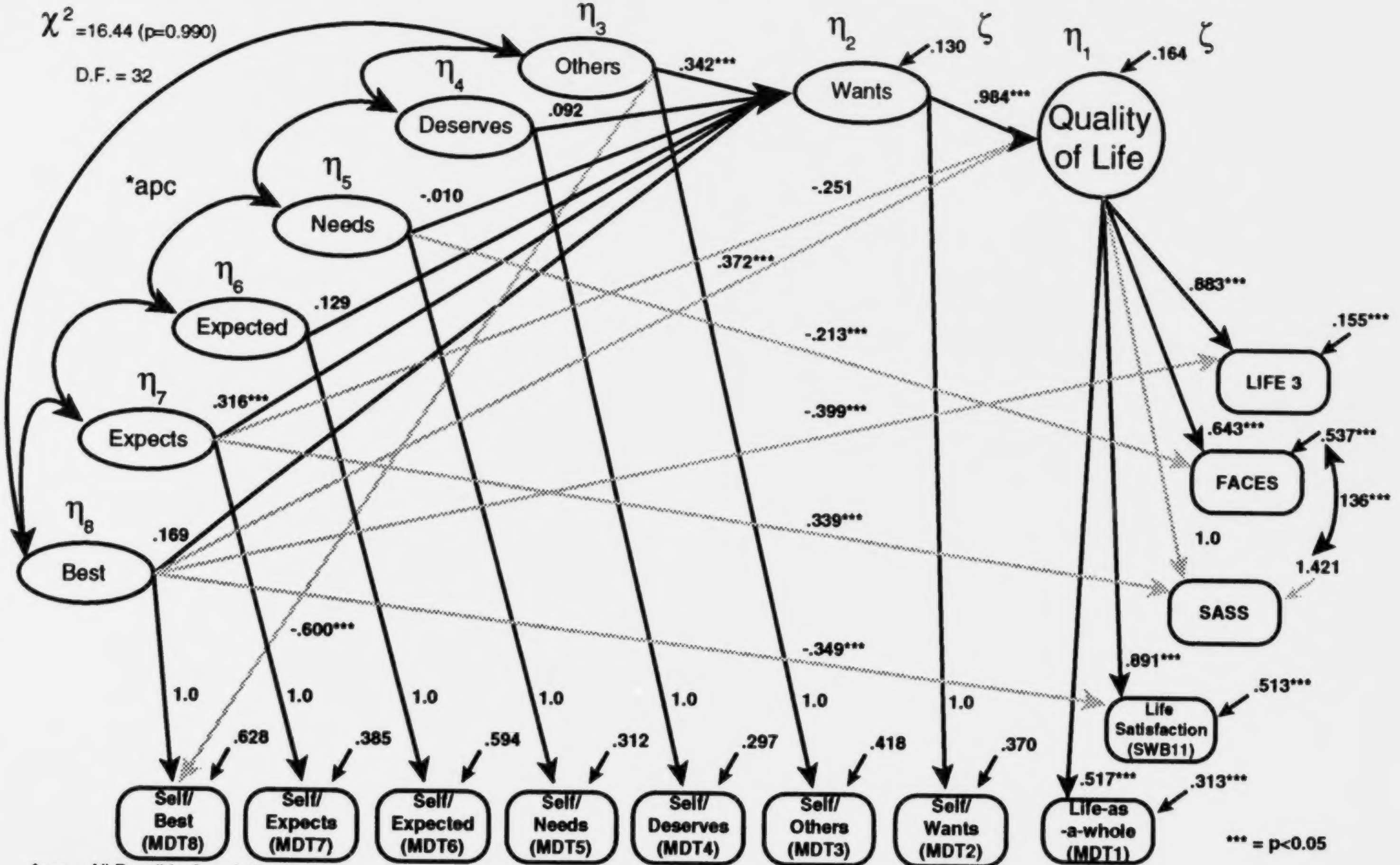
Given the adequate fit of the model, one might terminate further modifications. However, three additional lambda coefficients are freed purely as model fixes and lacking in theoretical explanation. First, a lambda coefficient between the concept NEEDS and the QOL indicator the Faces Scale is added to the coefficients to be estimated. The T-value for this coefficient is statistically significant ($t=-2.78$, $p<0.05$). The model fits the data well as demonstrated by a chi square of 25.72 ($p=0.845$) with 34 degrees of freedom.

The second data-driven model revision consists of adding a lambda coefficient to be estimated between the concept EXPECTS and the QOL indicator the SASS. The T-value for this coefficient is also statistically significant ($t=2.091$, $p<0.05$). With 33 degrees of freedom the chi square for the model is 21.13 ($p=0.945$).

The last model revision consists of adding a lambda coefficient to be estimated from the concept OTHERS to the self/best indicator which when estimated is statistically significant ($t=-2.051$, $p<0.05$). With 32 degrees of freedom the model chi square is 16.44 ($p=0.990$). Over-fitting of the model is acknowledged without hesitation. Several data-driven changes are likely capitalizing on change even if most can reasonably be defended. The maximum likelihood estimates for this final model of the effects of the MDT concepts on perceived QOL are found in Figure 6.5 and in Table 6.7.

The largest positive beta coefficient in the model shown in Figure 6.5 is for the effect of the concept WANTS on the concept perceived QOL. Every unit increase in the concept WANTS is expected to be accompanied by 0.984 units of increase in QOL. Similarly, a unit increase in the concept

Figure 6.5 The Effects of The Multiple Discrepancies Theory on Quality of Life (Final Model): Maximum Likelihood Estimates


χ^2 =16.44 (p=0.990)
D.F. = 32
*apc
η_3
Others
η_4
Deserves
η_5
Needs
η_6
Expected
η_7
Expects
η_8
Best
η_2
Wants
.130
ζ
η_1
Quality of Life
.164
ζ
.342***
.092
-.010
.129
.316***
.169
.984***
-.251
.372***
-.213***
-.399***
.339***
-.349***
-.600***
.883***
.643***
1.0
.891***
.517***
LIFE 3
.155***
FACES
.537***
136***
1.421
SASS
Life Satisfaction (SWB11)
.513***
Life-as -a-whole (MDT1)
.313***
1.0
1.0
1.0
1.0
1.0
1.0
1.0
.628
.385
.594
.312
.297
.418
.370
Self/ Best (MDT8)
Self/ Expects (MDT7)
Self/ Expected (MDT6)
Self/ Needs (MDT5)
Self/ Deserves (MDT4)
Self/ Others (MDT3)
Self/ Wants (MDT2)
*** = p<0.05

*apc = All Possible Correlations

Table 6.7 LISREL Maximum likelihood Estimates: Final Model

Lambda Coefficients

	QOL	WANTS	OTHERS	DESERVES	NEEDS	EXPECTED	EXPECTS	BEST
LIFE-AS-A-WHOLE	0.517*							
FACES	0.643*				-0.213*			
SASS	1.00						0.339*	
SWB11	0.891*							-0.349*
LIFE 3	0.883*							-0.399*
WANTS		1.0						
OTHERS			1.0					
DESERVES				1.0				
NEEDS					1.0			
EXPECTED						1.0		
EXPECTS							1.0	
BEST			-0.600*					1.0

Beta Coefficients

	QOL	WANTS	OTHERS	DESERVES	NEEDS	EXPECTED	EXPECTS	BEST
QOL	0.0	0.984*	0.0	0.0	0.0	0.0	-0.251	0.372*
WANTS	0.0	0.0	0.342*	0.092	-0.010	0.129	0.316*	0.169
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DESERVES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NEEDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BEST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Psi Variance

	QOL	WANTS	OTHERS	DESERVES	NEEDS	EXPECTED	EXPECTS	BEST
QOL	0.164							
WANTS	0.0	0.130						
OTHERS	0.0	0.0	0.773					
DESERVES	0.0	0.0	0.568	0.891				
NEEDS	0.0	0.0	0.567	0.769	0.935			
EXPECTED	0.0	0.0	0.245	0.333	0.293	0.891		
EXPECTS	0.0	0.0	0.005	0.152	0.155	0.046	0.384	
BEST	0.0	0.0	0.826	0.775	0.759	0.752	-0.027	1.650

Theta Epsilon (Measurement Error Variance)

	MDT1	FACES	SASS	SWB11	LIFE3	MDT2	MDT3	MDT4	MDT5	MDT6	MDT7	MDT8
LIFE-AS-A-WHOLE	0.313*											
FACES		0.537*										
SASS		0.136*	1.421									
SWB11				0.513*								
LIFE 3					0.155*							
WANTS						0.370						
OTHERS							0.418					
DESERVES								0.297				
NEEDS									0.312			
EXPECTED										0.594		
EXPECTS											0.385	
BEST												0.628

n=306

*=p<0.05

BEST is expected to be accompanied by 0.372 units of change in QOL. On the other hand, for every unit increase in the concept EXPECTS, one would anticipate a 0.251 unit decrease in QOL. To facilitate interpretation of this coefficient one must remember that the indicator of EXPECTS is worded in such a way that a lower score reflects a positive attitude toward one's future. This effect is not statistically significant.

In this final model of the effects of the MDT on QOL only two of the six MDT concepts have a statistically significant effect on the concept WANTS. The concepts OTHERS (.342) and EXPECTS (.316) have a significant positive effect on the WANTS concept. In contrast, Michalos (1983) found that of all the discrepancies variables, the 5-year expectation discrepancy was always the weakest predictor of WANTS. In this study, only the direct effect of EXPECTS on QOL is not statistically significant. This provides evidence that the effects of EXPECTS on QOL is not direct, but rather, is funneled through the concept WANTS.

Consistent with the findings of Michalos (1982), the concept OTHERS is a much stronger predictor of the WANTS concept than the BEST concept is. Michalos found that, in a group of Canadian seniors, comparison with other people of the same age was the primary determinant of the perceived self/want gap. Moreover, he found that the BEST and OTHERS concepts were stronger predictors of WANTS than of life-as-a-whole. In this study the direct effect of BEST on QOL is statistically significant; the effect on the WANTS concept is not. Therefore, the BEST concept is not contributing a great deal to the large effect that the WANTS concept has on QOL.

The total effects of each of the MDT concepts on QOL are provided in Table 6.8. The strongest total effects on the QOL concept are from the concept BEST, and to a less extent, OTHERS. The total effects of the concepts DESERVES, NEEDS, and EXPECTS on QOL are essentially zero. Finally, the total effect from the concept EXPECTED to QOL is weakly positive. Unanticipated effects from three MDT concepts to three QOL indicators is disturbing because of the threat to construct validity they represent. The first two effects, from the concept BEST to the QOL indicators, SWB11 and Life 3, are negative. A third effect from the concept NEEDS to the QOL indicator, the Faces Scale, is also negative. Finally, an effect from the concept EXPECTS to the QOL indicator, the SASS, is positive. Another negative effect, from the concept OTHERS to the self/best indicator, is evident.

Table 6.8 Total Effects of The MDT Concepts on QOL

Concept	**Direct Effect**	**Indirect Effect (Through WANTS)**	**Total Effect**
OTHERS		(.342)*(.984)*	.3365
DESERVES		(.092) (.984)*	.0905
NEEDS		(-.010) (.984)*	-.0098
EXPECTED		(.129) (.984)*	.1269
EXPECTS	-.251 +	(.316)*(.984)*	.0599
BEST	.372* +	(.169) (.984)*	.5383

* = $p<0.05$

To facilitate interpretation of the data-driven lambda coefficient estimates from several MDT concepts to the QOL indicators it is useful to examine the total effects. A total effect (indirect plus direct) from a concept to an indicator that is near zero means that there is no net change in the dependent variable as a result of a change in the causal variable. It implies no covariance between the causal concept and the indicator.

The total effects of three MDT concepts on four QOL indicators are found in Table 6.9. The total effects of the NEEDS concept on the Faces Scale is almost equal to the direct effect given the near zero indirect effect. The positive total effect of the EXPECTS concept on the SASS is the sum of equally strong direct and indirect effects. The negative direct and positive indirect effects of the concept BEST on SWB11 are counteractive resulting in a near zero total effect. Similarly, the negative direct effect accompanied by a positive indirect effect of the concept BEST on the Life 3 Scale results in a near zero total effect.

However, finding near zero total effects from the concept BEST to the QOL indicators Life 3 and SWB11 does not obviate the potentially devastating negative direct effects for the internal consistency of the QOL concept which demands proportionality among all the indicators. The fact that the direct effect of the concept BEST on QOL is positive and the direct effect of the concept on two of the QOL indicators is negative suggests that the indicators receiving the negative effects are not behaving like the other QOL indicators. The lack of covariance between the indicator of the concept BEST and the QOL indicators SWB11 and Life 3 suggests that these two QOL indicators are not consistent with other QOL indicators in the context of this external influence. The negative direct effects from BEST to Life 3 and SWB11 is, in effect, undoing the indirect effect through QOL.

Table 6.9 Total Effects of The MDT Concepts On QOL Indicators

Concept-Indicator	Direct Effect		Indirect Effect (Through WANTS)	Total Effect
NEEDS-Faces Scale	-.213	+	(-.010) (.984)*	-.2228
EXPECTS-SASS	.339	+	(.316)*(.984)*	.6499
BEST-SWB11	-.349	+	(.372)*(.984)*	.0170
BEST-Life 3 Scale	-.399	+	(.372)*(.984)*	-.0329

n=306 *= $p<0.05$

The squared multiple correlation for the QOL concept in Figure 6.5 is 0.883; that is, 88.3% of the variance in the QOL concept is explained by the MDT concepts. This is significantly more explained variance and with fewer predictors than has been demonstrated in the past. The gain in parsimony of the model by excluding demographic variables has not compromised the explained variance of QOL.

Michalos (1980) explained 57% of the variance in satisfaction with life-as-a-whole with 11 life domain satisfactions and 6 demographic variables and somewhat less (49%) of the variance for a group of senior Canadians with satisfaction in 12 domains plus two or three demographic variables (Michalos, 1982). More recently, Michalos (1983) accounted for 53% of the variance in satisfaction with life-as-a-whole with satisfaction in 12 domains of life and 6 or 7 demographic variables. He also explained 45% of the variance using four MDT variables (self/wants, self/best, self/others and self/expects). Similar to this study, Michalos found that the self/others variable was a stronger predictor of WANTS than the self/best variable. He also found that three MDT variables (self/others, self/best, and self/wants) were stronger predictors of satisfaction with life-as-a-whole than 19 other variables (satisfaction with life domains and demographic variables).

Michalos (1985) explained 53% of the variance in satisfaction with life-as-a-whole with the MDT variables. Consistent with this study, he also found that the strongest predictor of QOL was the WANTS concept followed by BEST and OTHERS, respectively. Michalos states " ...it is clear that the three discrepancy variables that I have worked with the most are the three most influential, namely, self/wants, self/others, and self/best" (Michalos, 1985, p. 382).

Moreover, Michalos (1985) found that the effect of the six discrepancy variables on the self/wants variables was stronger than that of the same six variables on satisfaction with life-as-a-whole, as would be expected, if the impact of the six variables on satisfaction with life-as-a-whole was most often indirect than direct. The results in this chapter generally support this assertion except that the direct effect from BEST to QOL is stronger than the indirect effect through WANTS.

In a group of 450 Ontario senior citizens, Michalos (1986) accounted for 35% of the variance in satisfaction with life-as-a-whole with the MDT variables. Two other findings are relevant for the present study. The first, is a significant direct effect from self/best to satisfaction with life-as-a-whole and the second is a significant indirect effect from self/others through self/wants. A contrary finding, however, was a significant effect on the self/want intervening variable from self/deserves, self/needs and self/best. Michalos assesses the self/deserves variable as a weak predictor. Indeed, in this study, the effects from the concepts DESERVES and NEEDS to the concept WANTS are the weakest in the model.

The squared multiple correlation for the WANTS concept in Figure 6.5 is 0.762, therefore, 76.2% of the variance in the WANTS concept is explained by the six other discrepancies concepts in the model particularly the concepts OTHERS and EXPECTS. The MDT concepts which fail to significantly affect the WANTS concept include: DESERVES, NEEDS, EXPECTED, and BEST. Therefore, the concepts OTHERS and EXPECTS alone are accounting for a large proportion of the variance in WANTS.

Michalos (1986) was able to explain only 29% of the variance in the self/wants variable with the other MDT variables plus gender. However, Michalos (1991a) recently accounted for 40% of the variance in the self/wants scores with the self/others variable being the strongest predictor, followed, in order, by the self/expected, self/needs, and self/deserves variables. The least predictive variables were self/best and self/expects, in that order.

Table 6.10 summarizes more concisely the revisions that were made to the model of the effects of the MDT concepts on perceived QOL. The first four of these model revisions were essential for achieving a chi square probability of 0.531. This was the case even when the lambda coefficients were added before the beta coefficients. The remaining three revisions resulted in an improved, even over-fitted, model but were not absolutely necessary; some may represent capitalization on chance. Moreover, these last revisions are inconsistent with the postulates of the MDT theory.

Table 6.10

The Effects Of The MDT Concepts On QOL: Model Revisions

Added Coefficient	**Chi square**	**Probability**
Beta (Best-QOL)	61.17	0.010
Beta (Expects-QOL)	56.31	0.022
Lambda (Best-Life 3)	44.61	0.154
Lambda (Best-SWB11)	33.69	0.531
Lambda (Needs-Faces Scale)	25.72	0.845
Lambda (Expects-SASS)	21.13	0.945
Lambda (Others-self/best)	16.44	0.990

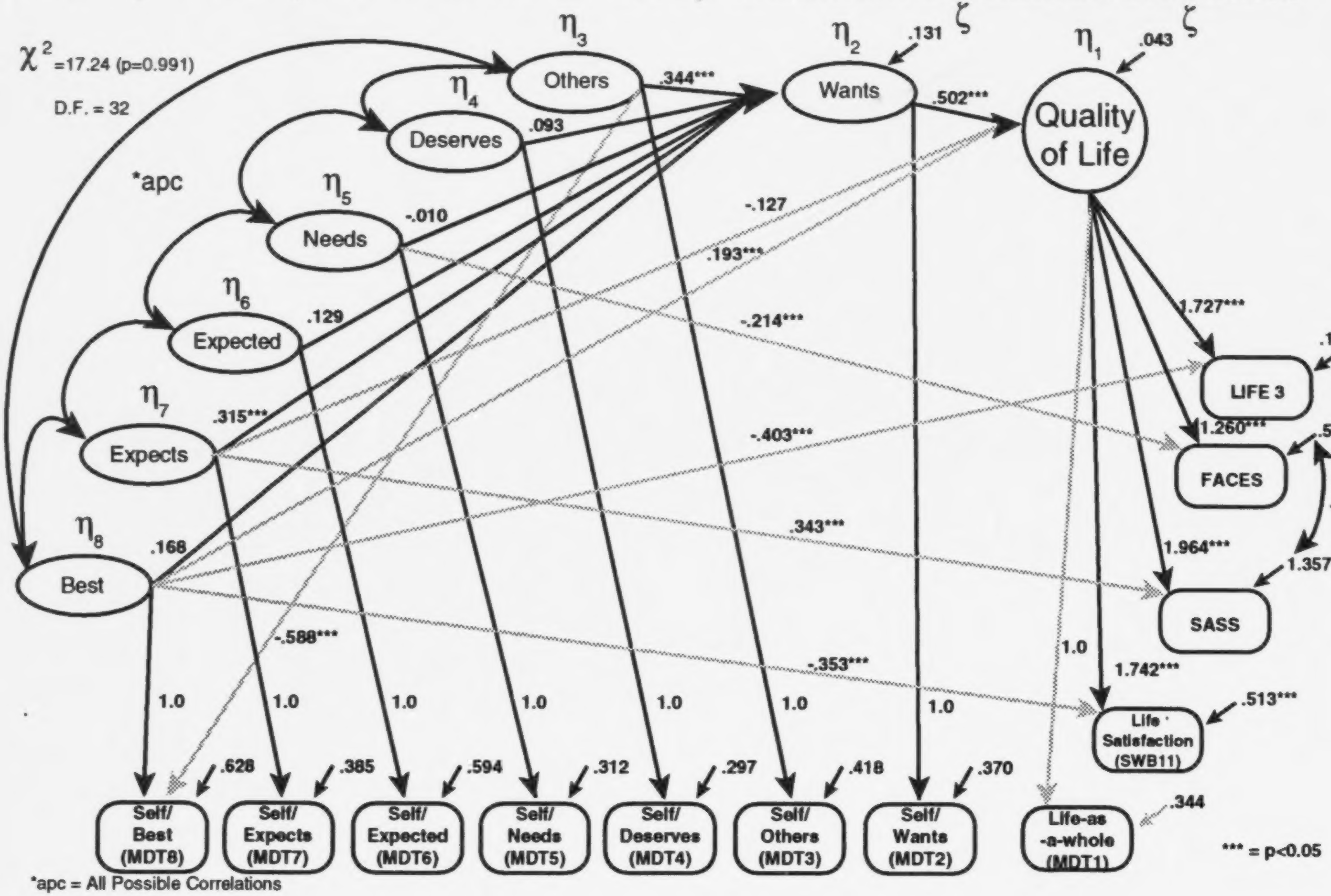
Scaling The QOL Concept With Life-as-a-Whole (MDT1)

A model is now constructed in which the concept perceived QOL is scaled to the satisfaction with life-as-a-whole item (MDT1) of the MDT rather than to the SASS (see Figure 6.6). This is achieved by fixing the lambda coefficient between the MDT1 item and perceived QOL at 1.0 and fixing the measurement error variance of MDT1 at 50% of the total observed variance. The lambda coefficient between QOL and the SASS and the measurement error variance of the SASS are free to be estimated. The model specification, in all other aspects, is identical to the model illustrated in Figure 6.5.

The chi square for this model with 32 degrees of freedom is 17.24 (p=0.984) compared to a chi square of 16.44 when the SASS is used to scale the QOL concept. There is little difference in the maximum likelihood estimates whether QOL is scaled with the MDT1 item or the SASS. Both models demonstrate the same statistically significant coefficients. The SMC for the QOL concept and the WANTS concept are the same regardless of whether the SASS or the MDT1 item is used to scale the QOL concept. Therefore, using either indicator to scale the QOL concept leads to essentially the same results.

A change in the meaning of the QOL concept was attempted by changing the size of the gap between the concept and the MDT1 indicator. By progressively decreasing the gap between

Figure 6.6 The Effects of The Multiple Discrepancies Theory on Quality of Life (MDT1 - Scale for QOL): Maximum Likelihood Estimates



χ^2 =17.24 (p=0.991)
D.F. = 32
*apc
η_3
η_2
η_1
η_4
η_5
η_6
η_7
η_8
ζ
ζ
.131
.043
Others
Wants
Quality of Life
Deserves
Needs
Expected
Expects
Best
.344***
.502***
.093
-.010
.129
.315***
.168
-.127
.193***
-.214***
-.403***
.343***
-.588***
-.353***
1.727***
1.260***
1.964***
1.742***
1.0
.155***
.533***
.124***
1.357***
.513***
.344
LIFE 3
FACES
SASS
Life Satisfaction (SWB11)
Life-as -a-whole (MDT1)
1.0
1.0
1.0
1.0
1.0
1.0
1.0
.628
.385
.594
.312
.297
.418
.370
Self/ Best (MDT8)
Self/ Expects (MDT7)
Self/ Expected (MDT6)
Self/ Needs (MDT5)
Self/ Deserves (MDT4)
Self/ Others (MDT3)
Self/ Wants (MDT2)
*** = p<0.05

*apc = All Possible Correlations

the MDT1 indicator and the QOL concept it was possible to assess the consequences of this change in conceptualization. The measurement error variance of the MDT1 item was sequentially fixed at 40%, 30%, 20%, and 10% of the total variance in the indicator. While the maximum likelihood estimates demonstrated little variation as a consequence of the changing meaning of the concept, the chi square of the model changed quite dramatically.

With the MDT1 indicator assigned 40% measurement error variance, the chi square of the model was 18.14 (p=0.977) and with 30% error variance, the chi square rose considerably to 36.59 (p=0.264). When the specified measurement error variance of MDT1 was decreased to 20% the chi square increased to 91.01 (p=0.00) and when the error variance was reduced to 10% LISREL could not converge to a solution. Therefore, it was not possible to successfully increase the similarity between the MDT1 indicator and the QOL concept. It was not possible to bring the MDT1 indicator any closer than the SASS indicator to the meaning of the QOL concept.

Summary

This chapter presents the investigation of the effects of the multiple discrepancies theory (MDT) on perceived QOL. The MDT, in both its current form and in the possibilities for revisions, is theoretically appealing in its substantive postulates. The notion of having an individual cognitively calculate the discrepancy between where they are in life compared to where they wish to be is one that has an advantage over most other proposed theories of QOL. The MDT can be universally applied because each individual has a unique set of values by which they judge the quality of their lives. Only the individual in question can evaluate QOL and assessing multiple discrepancies is a very appealing way to obtain the perceptions of the individual. The high multiple correlation for QOL suggests that one does not need a huge battery of questions from a variety of content domains to adequately assess QOL. One need only assess a few discrepancies to explain QOL assessments.

An especially theoretical appealing decision was to place the concept WANTS as an intervening variable between all other concepts of the MDT and the QOL concept. It would remain appealing even if the squared multiple correlation for QOL was not high because it creates parsimony at the structural level. The WANTS concept is strongly predictive but is not identical to the QOL concept. This consistently proved to be a very strong causal link in the LISREL models and Michalos can be highly commended on this particularly insightful theoretical hypothesis. Consistently, the goal/achievement gap link to QOL is the strongest in the system. Thus, there is supportive evidence that overall satisfaction with life is influenced more by the perceived gap between what one has and wants than by any other perceived gap in the model and there is also strong evidence that the perceived goal/achievement gap is itself influenced to varying degrees by the other perceived gaps. In other words, the goal/ achievement gap may be regarded as an intervening variable between satisfaction on one side and other gaps on the other side. In this study the BEST and OTHER concepts are stronger predictors of QOL than all the others.

The first suggestion for improvement in the theory would be to very carefully evaluate the wording of the questions. Clarity and precision in wording would improve the readability of the questions and enhance the subsequent ease of response. In particular, the question regarding expectations for the future requires rewording to avoid confusion which contributes to measurement error.

The final model of the effects of the MDT concepts on QOL fit the data well but an undesirable number of coefficients had to be added to obtain this good fit. An improved questionnaire design might make some of these data-driven changes unnecessary. Only the theorist can determine how tolerable some or all of these theoretical and data driven changes are. Parenthetically, it is noted that personal communication with Dr. Michalos supports the direct effects found from the concepts BEST and EXPECTS to QOL (Michalos, University of Guelph, personal communication, July 4, 1994).

VII. THE EFFECTS OF LIFE DOMAIN SATISFACTIONS ON PERCEIVED QUALITY OF LIFE

Campbell, Converse, and Rodgers (1976) propose that overall life satisfaction is a function of satisfaction with more specific domains of life such as friendships, family, and health. The assumption is that if individuals are dissatisfied with their current life situation, it is because certain features of their lives -- an unsatisfactory family life or poor health -- are particularly dissatisfying. Campbell et al. (1976), somewhat arbitrarily, chose to explore the satisfaction with 17 specific domains of life in order to determine which domains impacted on global satisfaction with life. Using multiple regression techniques, they were able to account for 54% of the variance in the composite measure, the Index of Well-Being (IWB).

Andrews and Withey (1976), who extended the study of Campbell et al. (1976), explored the relationship between a large number of life domains and global life satisfaction. In this study, which included a larger set of life domains, a larger proportion of the variance of similar global measures of subjective well-being (SWB) was accounted for by a smaller number of optimal predictors (12) than the 17 used by Campbell et al. (1976).

In the present study only 4 domains of life, judged to be most salient for this sample of respondents, were chosen as predictors of overall perceived quality of Life (QOL):

satisfaction with family, satisfaction with health, satisfaction with friends, and satisfaction with self. Only 4 life domains were chosen out of concern regarding the administration of a long battery of questionnaires to early post-surgical patients. Moreover, in the American sample (Campbell et al., 1976, p. 84), these four domains of life were ranked as among the most important domains of life in determining overall life satisfaction. Andrews and Withey (1976) also found that domains of life in which individuals were immediately and personally involved best predicted global life satisfaction.

Two sets of four questions exploring satisfaction with 4 life domains (family, health, friends, and self) were administered to the CABG surgical patients. The 4 questions of Campbell et al. (1976) include a bipolar scale with completely dissatisfied at the left of 7 equally spaced lines and completely satisfied at the extreme right. The middle spaces are without labels (see Table 7.1). The second set of life domain questions (Andrews and Withey, 1976) differ from those of Campbell et al. in that the 7-point scale is labeled with descriptors ranging from terrible to delighted (see Table 7.2). The objective is to compare the descriptive statistics and the measurement error variance of these two sets of questions and to determine how they affect the fit of the subsequent structural equation models.

Table 7.1

Life Domain Satisfaction Questions: Satisfaction Scale
(Campbell, Converse, & Rodgers, 1976)

Satisfaction with family life. All things considered, how satisfied are you with your family life - the time you spend and the things you do with members of your family. Which number comes closest to how you feel? (1976, p. 553)

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Satisfaction with Health. Of course, most people get sick now and then, but overall, how satisfied are you with your own health? Which number comes closest to how you feel? (1976, p. 545).

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Satisfaction with Friends. All things considered, how satisfied are you with your friendships - with the time you spend with friends, the things you do together, the number of friends you have, as well as the particular people who are your friends? Which number comes closest to how you feel? (1976, p. 547).

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Satisfaction with Self. How do you feel about how you have been able to satisfy your ambitions in life up to now? (Adapted from 1976, p. 556).

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Table 7.2

Life Domain Satisfaction Questions: Delighted-Terrible Scale
(Andrews and Withey, 1976)

Satisfaction with Family. How do you feel about the things you and your family do together? (1976, p. 363)

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied and dissatisfied)	Mostly Satisfied	Pleased	Delighted

Satisfaction with Health. How do you feel about your own health and physical condition? (1976, p. 363)

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied and dissatisfied)	Mostly Satisfied	Pleased	Delighted

Satisfaction with Friends. How do you feel about your friends? (1976, p. 368).

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied and dissatisfied)	Mostly Satisfied	Pleased	Delighted

Satisfaction with Self. How do you feel about what you have accomplished in your life? (1976, p. 363).

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied and dissatisfied)	Mostly Satisfied	Pleased	Delighted

Descriptive Statistics

The descriptive statistics for each of the life domain satisfaction items are presented in Table 7.3 (Satisfaction Scale) and Table 7.4 (Delighted-Terrible Scale). The mean scores for all the life domain Satisfaction Scale items are in the positive range. Among the 4 domains listed in Table 7.3, the highest mean score reported is for satisfaction with family. Campbell et al. (1976) found that satisfaction with marriage was the highest rated domain satisfaction followed by satisfaction with family life. The mean family satisfaction score for the American sample (n=2074) was 5.92 compared to 5.578 for post-CABG surgical patients.

The second highest mean score reported in Table 7.3 is for the domain of friends (5.559). This value is slightly lower than the mean score (5.74) for the American sample (N=2151). The third highest mean score is for the domain satisfaction with self (5.134). This Satisfaction Scale item was adapted for the study from a similar item asked by Campbell et al. (1976) in order to have an item on the Satisfaction Scale measuring satisfaction with self parallel to an item constructed by Andrews and Withey (1976) on the D-T Scale. Finally, as anticipated for individuals recovering from surgery, the satisfaction with health is the lowest of the domain mean scores. Compared to a mean score of 5.78 for relatively healthy Americans, the mean satisfaction with health score for the CABG surgical patients is 5.1.

Table 7.3

Descriptive Statistics For Domain Satisfaction Variables

Satisfaction Scale

Statistic	**Family**	**Health**	**Friends**	**Self**
Range of scores possible on item	1-7	1-7	1-7	1-7
Observed range	6	6	5	6
Mean	5.578	5.111	5.559	5.134
Median	6	5	6	5
Mode	6	5	6	6
Standard Deviation	1.25	1.276	1.107	1.203
Standard error	0.071	0.073	0.063	0.069
Skewness	-1.127	-0.839	-0.712	-0.647

n=306

The descriptive statistics for the life domain questions using the Delighted-Terrible (D-T) Scale (see Table 7.4) reveal that, like the Satisfaction Scale responses, the family life domain is most satisfying to the CABG surgical patients. The mean score is 5.5 compared to a mean score of 5.8 for the American survey conducted in May of 1972 (N=1297) and a mean score of 5.4 in the November 1972 survey (N=1118).

The second highest mean score, for the friends life domain, is 5.5; this is very similar to the mean score (5.6) for the American sample in the November 1972 survey (N=1118). The mean score for the life domain of self is 5.23 with a standard deviation of 0.863. This is essentially identical to the mean score of the American samples of May 1972 (N=1297) and April 1973 (N=1433). The lowest satisfaction is expressed for the domain of health (4.97). Compared to the mean scores of the American sample of May 1972 and November 1972 which were 5.3 and 5.1, respectively, this mean health satisfaction score of the CABG surgical patients is not as low as one might expect.

Table 7.4

Descriptive Statistics For Domain Satisfaction Variables

Delighted-Terrible Scale

Statistic	**Family**	**Health**	**Friends**	**Self**
Range of scores possible on item	1-7	1-7	1-7	1-7
Observed range	6	6	4	4
Mean	5.500	4.971	5.471	5.235
Median	6	5	5	5
Mode	6	5	5	5
Standard Deviation	1.038	1.054	0.846	0.863
Standard error	0.059	0.060	0.048	0.049
Skewness	-0.886	-0.652	-0.251	-0.289

n=306

Distribution of Life Domain Satisfaction Responses

Table 7.3 and Table 7.4 reveal that the Satisfaction Scale items are more negatively skewed than the D-T Scale items. Campbell et al. (1976) found that their Satisfaction Scale produced markedly skewed distributions for many of the domains they studied. Typically, half to two-thirds of their respondents selected one of the two most satisfying categories. Andrews and Withey (1976) created the D-T Scale in an attempt to separate these groups.

Table 7.5 provides the distributions of the responses to the two sets of questions: the Satisfaction Scale and the D-T

Table 7.5 Distributions of Responses to Life Domain Questions

Family

Dissatisfied	1	2	3	4	5	6	7	Satisfied
	1%	**2%**	**3%**	**9%**	**27%**	**33%**	**25%**	

Health

Dissatisfied	1	2	3	4	5	6	7	Satisfied
	2%	**2%**	**7%**	**13%**	**34%**	**30%**	**11%**	

Friends

Dissatisfied	1	2	3	4	5	6	7	Satisfied
	0%	**1%**	**3%**	**12%**	**26%**	**38%**	**20%**	

Self

Dissatisfied	1	2	3	4	5	6	7	Satisfied
	0%	**2%**	**8%**	**15%**	**30%**	**34%**	**10%**	

Family

Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
0%	**1%**	**2%**	**11%**	**31%**	**41%**	**14%**

Health

Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
0%	**2%**	**6%**	**21%**	**37%**	**30%**	**3%**

Friends

Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
0%	**0%**	**2%**	**9%**	**41%**	**39%**	**10%**

Self

Terrible	Unhappy	Mostly Dissatisfied	Mixed	Mostly Satisfied	Pleased	Delighted
0%	**0%**	**3%**	**16%**	**42%**	**35%**	**5%**

Scale. Of the life domains examined, an average of 44% of the CABG surgical patients chose the top two categories of the D-T Scale whereas 50% chose the top two categories of the Satisfaction Scale. Between 12% (D-T Scale) and 14% (Satisfaction Scale) of respondents chose the mid-point of the scales.

About half as many CABG surgical patients chose the delighted (7) descriptor of the D-T Scale items as chose the completely satisfied (7) descriptor of the Satisfaction Scale items (see Table 7.5). About equal proportions of respondents chose the second most positive option in both sets of questions. Somewhat more respondents chose the mostly satisfied (5) descriptor of the D-T Scale than the fifth option for the Satisfaction Scale. Roughly 1% of respondents selected the completely dissatisfied (1) option of the Satisfaction Scale and not a single individual selected the terrible (1) option of the D-T Scale.

Both labeled-category and non-labeled-category scales have long histories in survey research but Andrews and Withey (1976) believe that labeled-category scales have the advantage of greater precision in meaning at the data collection phase of research. Greater precision in meaning is thought to lead to better comparability in the way respondents use the scales and to lower measurement error. From Table 7.5 one can conclude that the D-T Scale produces a slightly more normal distribution of responses than the

Satisfaction Scale.

A question still lingers regarding the connotations of the terms completely dissatisfied and terrible for these respondents. The latter has an affective tone while the former possesses a judgmental tone. Similarly delighted and completely satisfied appear to have dissimilar affective content. One is left, then, with little explanation of why the respondents chose satisfied more readily than delighted.

Correlations Among The Life Domain Satisfaction Variables

The correlations among the eight items which measure four life domain satisfactions appear in Table 7.6. In every case, the two items which measure the same domain of life demonstrate a stronger correlation with each other than with any other variable in the matrix. However, the correlation between the two items which measure satisfaction with self and the two items which measure satisfaction with family are only moderate in strength.

The strongest correlation is between the two items which measure satisfaction with one's health (0.7464). The second largest correlation in the matrix is between the two items which measure satisfaction with friends (0.7129). The lowest correlation in the matrix is between the two Satisfaction Scale items which measure satisfaction with health and satisfaction with family (0.2495).

Table 7.6

Correlations Among The Life Domain Satisfaction Variables

	Family	**Health**	**Friends**	**Self**	**Family**	**Health**	**Friends**	**Self**
	Satisfaction Scale				D-T Scale			
Family	1.0	.2495	.5003	.4126	**.6811**	.2793	.3650	.4449
Health		1.0	.3113	.3406	.2923	**.7464**	.2705	.3039
Friends			1.0	.3499	.4126	.3206	**.7129**	.3289
Self				1.0	.3374	.3186	.3212	**.5980**
Family					1.0	.3253	.3884	.3405
Health						1.0	.3503	.2961
Friends							1.0	.3285
Self								1.0

n=306

Family = Satisfaction with family
Health = Satisfaction with health
Friends = Satisfaction with friends
Self = Satisfaction with self

Correlations Among The Life Domain Satisfaction Variables And The Quality of Life Indicators

The correlations among the life domain satisfaction measures and the QOL measures are presented in Table 7.7. The pattern of the correlations is fairly uniform and most are of moderate size. The highest correlation is between the life-as-a-whole item (MDT1) and the item measuring satisfaction with health on the D-T Scale (0.4941). The MDT1 item uses a scale which is an adaptation of the original D-T Scale.

The second highest correlation (0.4905) is between the satisfaction with self item measured on the D-T Scale and the QOL indicator Life 3, which is also measured on the D-T Scale. The third highest correlation (0.4772) is between the satisfaction with self item measured on the Satisfaction Scale and the QOL indicator Life 3. The lowest correlation in the matrix is between the item measuring satisfaction with friends on the D-T Scale and the QOL indicator MDT1 (0.2164).

Table 7.7

Correlations Among The Life Domain Satisfaction Variables And The Quality Of Life Indicators

Variable	MDT1	Faces	SASS	SWB11	Life 3
Satisfaction Scale					
Family	.3672	.3521	.3707	.4170	.4522
Health	.3925	.3899	.4342	.3587	.3436
Friends	.2741	.3123	.2181	.3275	.3458
Self	.3384	.3938	.4109	.4457	.4772
Delighted-Terrible Scale					
Family	.3101	.3516	.2820	.3807	.4446
Health	.4941	.4488	.4691	.4616	.4610
Friends	.2164	.2932	.2315	.3320	.3434
Self	.3441	.4392	.4539	.4730	.4905

n=306

LISREL Models Of The Effects Of The Life Domains Satisfactions On Quality of Life

This section consists of a description and evaluation of two models of the effects of the life domain satisfactions on perceived QOL. The first model (henceforth called the Satisfaction Scale Model) uses the Satisfaction Scale items of Campbell et al. (1976) to scale the life domain satisfaction concepts while the second model (hereafter called the D-T Scale Model) uses the corresponding D-T scale items of Andrews and Withey (1976) to scale the concepts. The discussion surrounds the modeling history of these models.

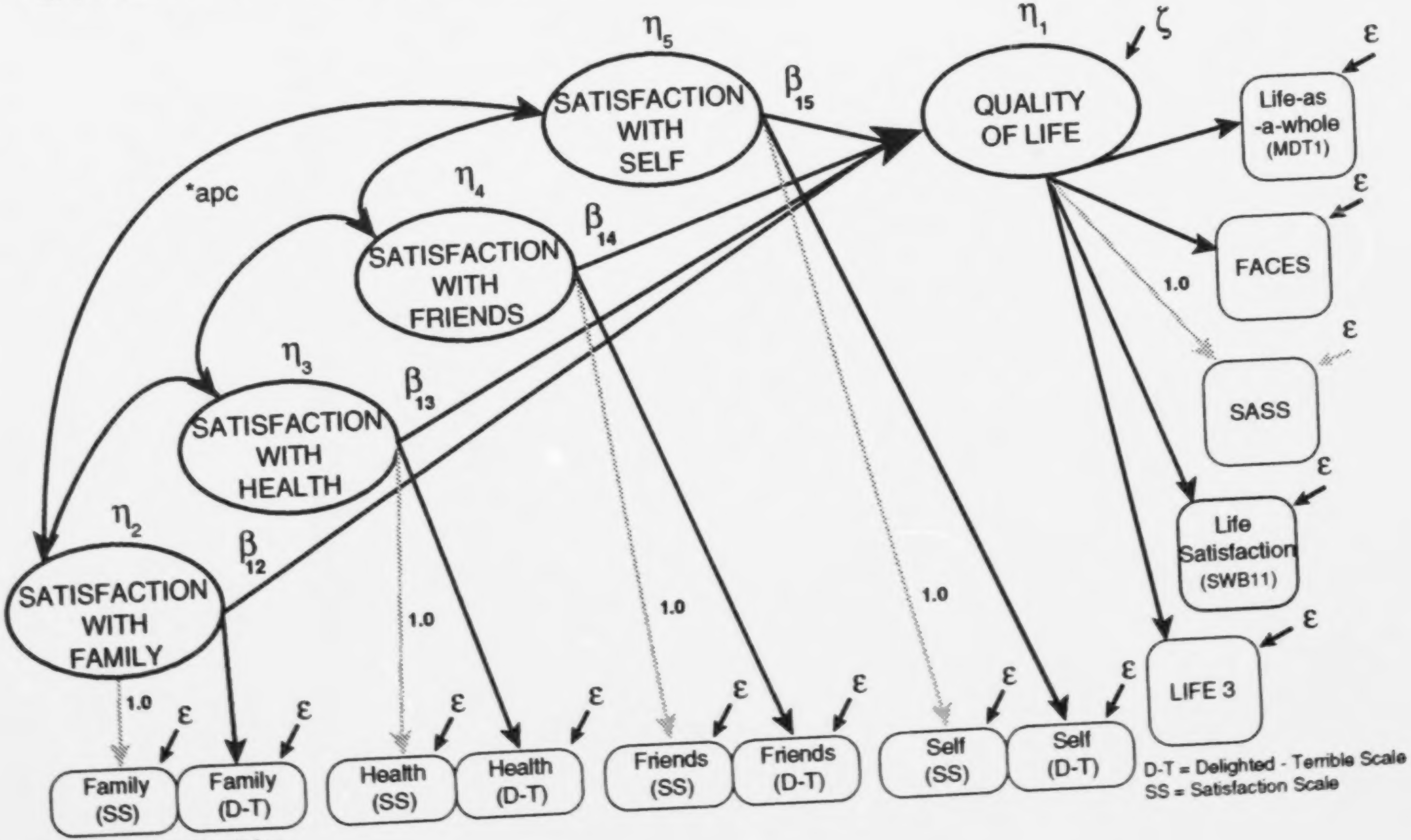
The Effects of The Life Domain Satisfactions On Perceived QOL

The Satisfaction Scale

The Satisfaction Scale Model of the effects of the life domain satisfactions on perceived QOL consists of 5 concepts (see Figure 7.1). They include QOL, satisfaction with family, satisfaction with health, satisfaction with friends, and satisfaction with self.

Each of the life domain satisfaction concepts is measured by two indicators; one is the responses to the life domain questions on the Satisfaction Scale and the other is the responses to the life domain questions on the D-T Scale. In the Satisfaction Scale Model, the life domain satisfaction concepts are scaled to the Satisfaction Scale responses. The lambda coefficients from each of the four life domain satisfaction concepts are fixed at a value of 1.0 to their

Figure 7.1 THE EFFECTS OF LIFE DOMAIN SATISFACTIONS ON QUALITY OF LIFE (Satisfaction Scale): Parameter Specifications


η_5
SATISFACTION WITH SELF
β_{15}
η_1
ζ
QUALITY OF LIFE
ε
Life-as -a-whole (MDT1)
*apc
η_4
SATISFACTION WITH FRIENDS
β_{14}
FACES
1.0
SASS
η_3
SATISFACTION WITH HEALTH
β_{13}
Life Satisfaction (SWB11)
η_2
SATISFACTION WITH FAMILY
β_{12}
LIFE 3
Family (SS)
Family (D-T)
Health (SS)
Health (D-T)
Friends (SS)
Friends (D-T)
Self (SS)
Self (D-T)

D-T = Delighted - Terrible Scale
SS = Satisfaction Scale

*apc = All Possible Correlations

respective indicators on the Satisfaction Scale. The lambda coefficients between the four life domain satisfaction concepts and the respective responses on the D-T Scale are free to be estimated. The measurement error variance of each of the life domain satisfaction indicators (both the Satisfaction Scale and the D-T Scale items) are free to be estimated with starting values of 35% of the total observed variance.

The indicators of the perceived QOL concept include the life-as-a-whole item (MDT1), the Faces Scale, the SASS, the Life Satisfaction item (SWB11) of the IWB, and the Life 3 Scale. The QOL concept is scaled to the SASS indicator by fixing the lambda coefficient between them at a value of 1.0. The measurement model of QOL is discussed in detail in Chapter III and Chapter IV.

With 55 degrees of freedom the chi square of the Satisfaction Scale Model is 93.16 (p=0.001) indicating a poor fit between the model-implied covariance matrix and the sample data matrix. All of the coefficients which are free to be estimated, save for one, are statistically significant. Satisfaction with friends has a weak and negative effect on perceived QOL.

With little available theoretical guidance, the majority of the subsequent model revisions are guided by the investigator's knowledge of the data collection procedure, and somewhat less, by the diagnostics of the LISREL output.

The model revisions required to obtain an adequately fitting model for both the Satisfaction Scale Model and the D-T Scale Model are summarized in Table 7.8. The following discussion leads to the conclusion that identical modifications are required for both models (one using the Satisfaction Scale items to scale the life domain satisfaction concepts and the other using the D-T Scale items to scale the concepts) and the final models are virtually identical.

Before discussing these modifications it is necessary to mention that near completion of writing this chapter a negative measurement error variance for one of the indicators was discovered. Recognized as a bizarre estimate, a search for an explanation was implemented. The model revisions were reversed until the trouble was located. The negative measurement error variance (-0.094) for the indicator of the concept satisfaction with health (D-T Scale) appeared when a lambda coefficient was inserted between the concept satisfaction with self and the indicator of satisfaction with health (Satisfaction Scale). Examining the LISREL diagnostics failed to provide a clue for why the variances and covariances in the data were inconsistent with the model-implied variances and covariances. When this lambda coefficient was abandoned the remaining modifications proceeded without difficulty and all subsequent estimated coefficients were reasonable.

Table 7.8 Modeling History

Satisfaction Scale Model

Addition	**Chi square**	**p**	**D.F.**
Basic Model	93.16	0.001	55
Lambda (SELF to MDT1)	80.88	0.010	54
TE (Family [SS]-Friends [D-T])	67.36	0.089	53
Lambda (HEALTH to family [D-T])	61.40	0.175	52
TE (Life 3-health [SS])	54.19	0.354	51
TE (Life 3-health [D-T])	46.53	0.614	50
TE (Life 3-family [D-T])	42.92	0.717	49

D-T Scale Model

Addition	**Chi square**	**p**	**D.F.**
Basic Model	93.34	0.001	55
Lambda (SELF to MDT1)	80.88	0.010	54
TE (Family [SS]-Friends [D-T])	67.36	0.089	53
Lambda (HEALTH to family [D-T])	61.40	0.175	52
TE (Life 3-health [SS])	54.19	0.354	51
TE (Life 3-health [D-T])	46.53	0.614	50
TE (Life 3-family [D-T])	42.92	0.717	49

TE = theta epsilon (measurement error variance)
Lambda = lambda coefficient
SS = Satisfaction Scale
DT = Delighted-Terrible Scale

The first revision of the Satisfaction Scale Model consists of adding an effect (lambda coefficient) to be estimated from the concept satisfaction with self to the QOL indicator, life-as-a-whole (MDT1). When estimated this unexpectedly negative coefficient (-0.355) is statistically significant (t=-3.014, p<0.05). With 54 degrees of freedom the chi square for this model is 80.88 (p=0.010). The four life domain satisfaction concepts account for 78.8% of the variance in perceived QOL.

The LISREL diagnostics suggested permitting a correlation between the measurement errors of the indicator of satisfaction with family (Satisfaction Scale) and of satisfaction with friends (D-T Scale). This coefficient, when added to those to be estimated, is statistically significant ($t=-3.524$, $p<0.05$). With 53 degrees of freedom the chi square for the model is substantially lower at 67.36 ($p=0.089$). All of the effects (beta coefficients) to QOL from the life domain concepts, except friends, continue to be statistically significant.

The modification indices suggested freeing a coefficient between the concept satisfaction with health and the indicator of satisfaction with family (D-T Scale). A lambda coefficient was added, and when estimated, is statistically significant ($t=2.494$, $p<0.05$). With 52 degrees of freedom the chi square of this model is 61.40 ($p=0.175$).

The LISREL diagnostics then suggested freeing the correlation between the measurement errors of the QOL indicator Life 3 and of the indicator of satisfaction with health (Satisfaction Scale). This data-driven model revision was implemented even though, at this point, the model-implied covariance matrix and the data matrix are demonstrating a reasonable fit. The estimated coefficient (-0.071) is statistically significant ($t=-2.787$, $p<0.05$). With 51 degrees of freedom, the chi square is 54.19 ($p=0.354$) and the goodness of fit index (GFI) 0.974.

The LISREL diagnostics suggested freeing the correlation between the measurement errors of the QOL indicator Life 3 and the satisfaction with health indicator (D-T Scale). With this model revision, the coefficient (-0.076) is statistically significant (t=-2.888, p<0.05). With 50 degrees of freedom, the chi square is 46.53 (p=0.614). The model accounts for 81.3% of the variance in QOL.

The last revision to the Satisfaction Scale Model consists of freeing the correlation between the measurement errors of the QOL indicator Life 3 and the satisfaction with family indicator (D-T Scale). However, this coefficient is not statistically significant (t=1.879, P>0.05) and with 49 degrees of freedom the chi square is 42.92 (p=0.717). The model accounts for 81.0% of the variance in QOL. The maximum likelihood estimates are presented in Table 7.9 and are illustrated in Figure 7.2.

The effects of satisfaction with family (0.180), satisfaction with health (0.525), and satisfaction with self (0.716) on QOL are all statistically significant. The effect of satisfaction with self on QOL is particularly strong (beta standardized = 0.545) followed by the effect of satisfaction with health (beta standardized = 0.448). Satisfaction with family exhibits the third strongest effect on QOL. The effect of satisfaction with friends on QOL is unexpectedly negative and insignificant (beta standardized =-0.089).

Table 7.9 Maximum Likelihood Estimates: The Effects of Life Domain Satisfactions On Quality of Life (Satisfaction Scale)

Lambda Coefficients

	QOL	FAMILY	HEALTH	FRIENDS	SELF
MDT1	.675*				-.302*
Faces	.538*				
SASS	1.0				
SWB11	.598*				
Life 3	.527*				
FAMILY (SS)		1.0			
FAMILY (DT)		.586*	.137*		
HEALTH (SS)			1.0		
HEALTH (DT)			.979*		
FRIENDS (SS)				1.0	
FRIENDS (DT)				.751*	
SELF (SS)					1.0
SELF (DT)					.761*

Beta Coefficients

	QOL	FAMILY	HEALTH	FRIENDS	SELF
QOL		.180*	.525*	-.113	.716*

PSI Variance

	QOL	FAMILY	HEALTH	FRIENDS	SELF
QOL	.269*				
FAMILY		1.412*			
HEALTH		.384*	1.029*		
FRIENDS		.685*	.407*	.887*	
SELF		.623*	.397*	.434*	.818*

Measurement Error Variance

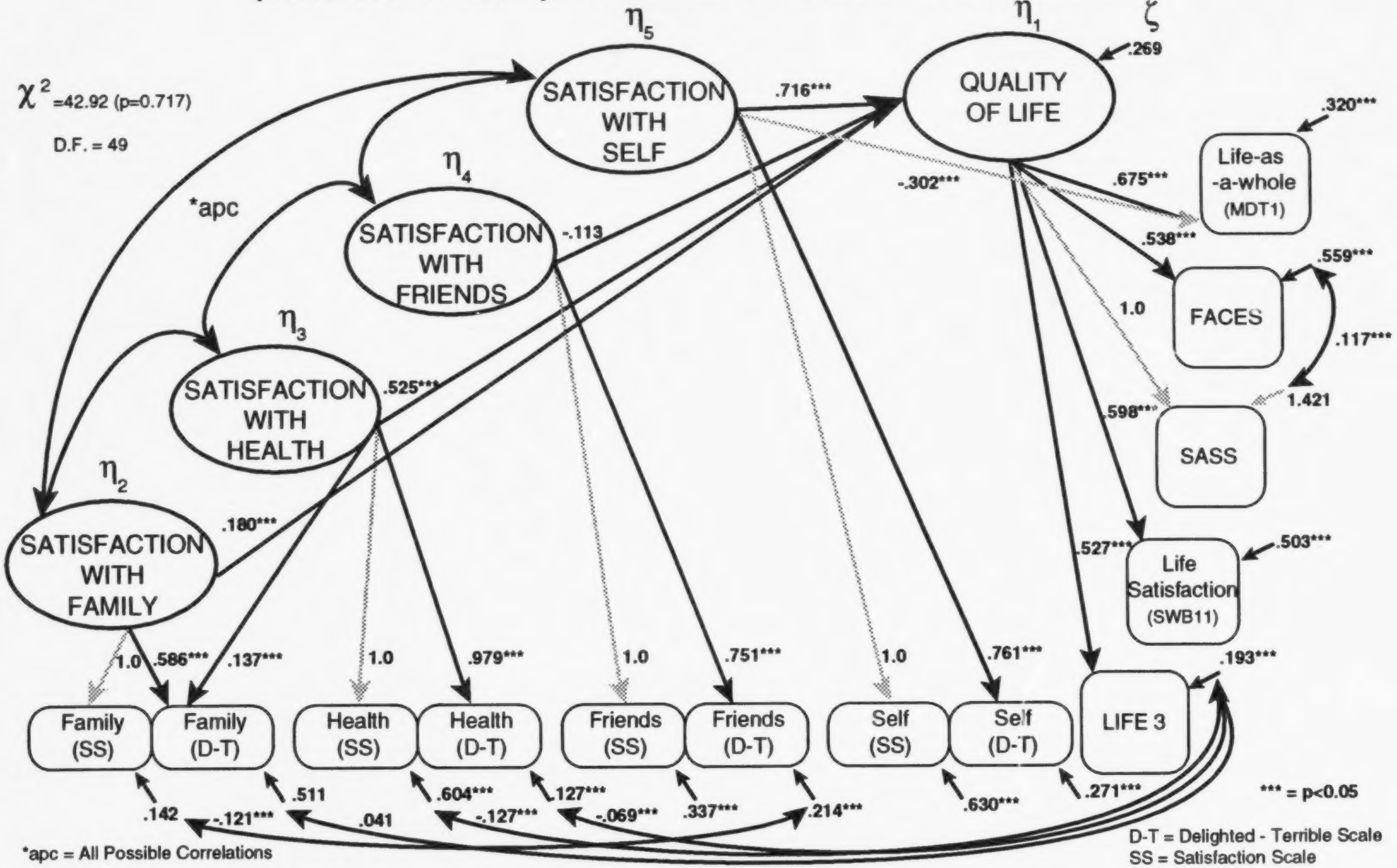
	MDT1	Faces	SASS	SWB11	Life 3	FAMILY	FAMILY	HEALTH	HEALTH	FRIENDS	FRIENDS	SELF	SELF
MDT1	.320*												
Faces		.559*											
SASS		.117*	1.421										
SWB11				.503*									
Life 3					.193*								
FAMILY (SS)						.142							
FAMILY (DT)					.041		.511*						
HEALTH (SS)					-.127*			.604*					
HEALTH (DT)					-.069*				.127*				
FRIENDS (SS)										.337*			
FRIENDS (DT)						-.121*					.214*		
SELF (SS)												.630*	
SELF (DT)													.271*

n=306 * = P<0.05

SS = Satisfaction Scale

DT = Delighted-Terrible Scale

Figure 7.2 THE EFFECTS OF LIFE DOMAIN SATISFACTIONS ON QUALITY OF LIFE (Satisfaction Scale): MAXIMUM LIKELIHOOD ESTIMATES


χ^2 =42.92 (p=0.717)
D.F. = 49
*apc
η_5
SATISFACTION WITH SELF
η_1
ζ
.269
QUALITY OF LIFE
.716***
η_4
SATISFACTION WITH FRIENDS
-.113
η_3
SATISFACTION WITH HEALTH
.525***
η_2
SATISFACTION WITH FAMILY
.180***
-.302***
.675***
.538***
1.0
.598***
.527***
Life-as -a-whole (MDT1)
.320***
FACES
.559***
.117***
SASS
1.421
Life Satisfaction (SWB11)
.503***
LIFE 3
.193***
1.0
.586***
.137***
1.0
.979***
1.0
.751***
1.0
.761***
Family (SS)
Family (D-T)
Health (SS)
Health (D-T)
Friends (SS)
Friends (D-T)
Self (SS)
Self (D-T)
.142
-.121***
.511
.041
.604***
-.127***
.127***
-.069***
.337***
.214***
.630***
.271***

*apc = All Possible Correlations

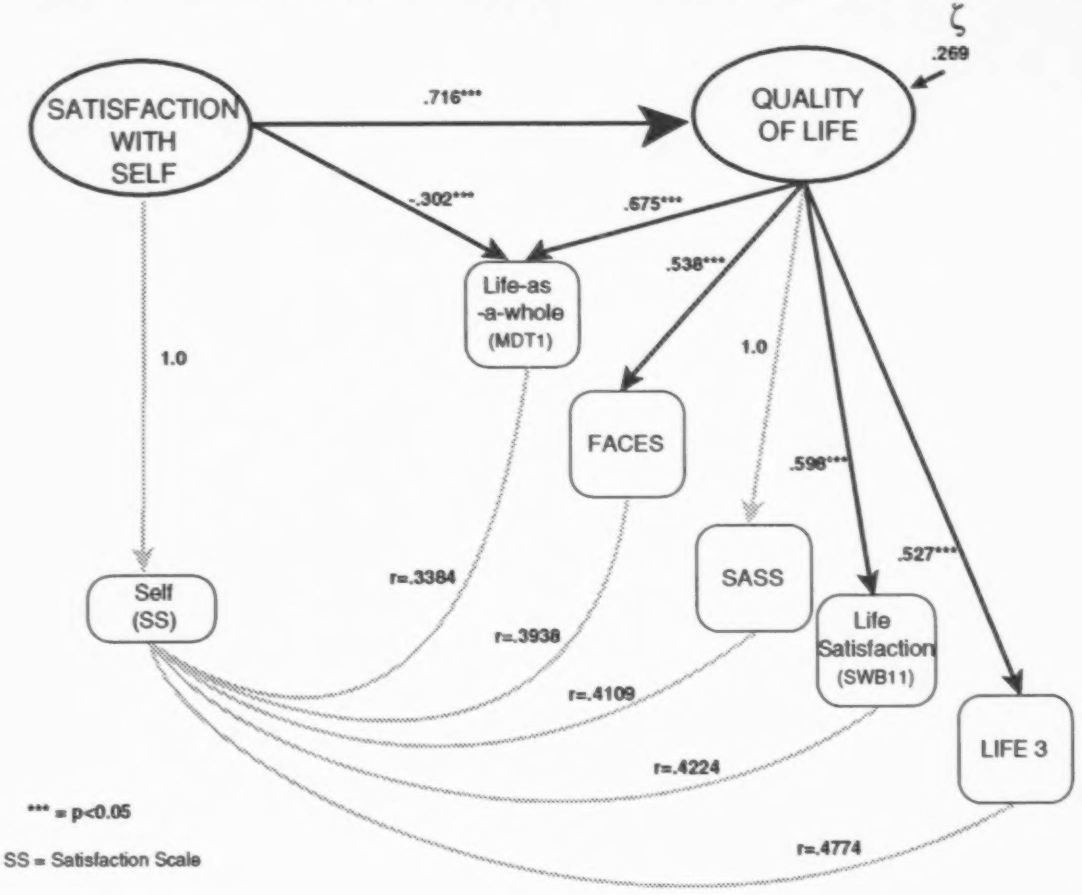
*** = p<0.05

D-T = Delighted - Terrible Scale
SS = Satisfaction Scale

The negative effect (-0.302) from the concept satisfaction with self to the QOL indicator life-as-a-whole (MDT1) is problematic and difficult to reconcile because a concept other than QOL is influencing a QOL indicator. This negative lambda coefficient must be explored in more detail because the nature of this estimate, although previously involving the QOL indicators the Life 3 Scale and SWB11, has appeared in Chapters V and VI as well. The reason a negative lambda coefficient is necessary between various causal concepts and these QOL indicators is because the correlations between them is lower than between these concepts and the other QOL indicators. Figure 7.3, which reveals the correlations between the satisfaction with self indicator and the QOL indicators, illustrates this point more clearly.

The figure shows two concepts, QOL and satisfaction with self. The estimated coefficients are taken from Figure 7.2. For simplicity, only one satisfaction with self indicator is displayed. Note that the correlations between the satisfaction with self indicator and the four QOL indicators, the Faces Scale, the SASS, SWB11, and the Life 3 Scale are stronger than the correlation between the satisfaction with self indicator and the QOL indicator MDT1. To match up with the strong correlations between the indicator of satisfaction with self and the four other QOL indicators, a strong beta coefficient is needed between the concepts satisfaction with self and QOL. However, a weaker beta coefficient is needed

Figure 7.3 THE EFFECT OF SATISFACTION WITH SELF ON LIFE-AS-A-WHOLE (MDT1)


ζ
.269
SATISFACTION WITH SELF
QUALITY OF LIFE
.716***
-.302***
.675***
.538***
1.0
.598***
.527***
1.0
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 3
Self (SS)
r=.3384
r=.3938
r=.4109
r=.4224
r=.4774

*** = $p<0.05$

SS = Satisfaction Scale

to match up with the correlation between the satisfaction with self indicator and the MDT1. That is, the total effect (direct plus indirect effect) of satisfaction with self on MDT1 should be weaker than the total effect of satisfaction with self on the other indicators of QOL if the model-implied covariances are to be congruent with the data covariances.

One way to provide for a weaker total effect of the concept satisfaction with self on MDT1 is to add in the problematic direct negative effect so that the total effect is now lower than with the indirect effect alone. As a result, one is inclined not to interpret the negative effect of satisfaction with self on MDT1 as an actual effect, but rather, as an artifact of the inconsistent behavior of the MDT1 indicator. In short, the MDT1 indicator is not behaving in conjunction with the other indicators of QOL. A parallel discussion could have, and perhaps should have, been made of similar negative direct effects on two QOL indicators discovered in previous chapters.

Turning again to the structural effects in the model, the satisfaction with self concept was unquestionably an important predictor of the QOL concept in this study. This is consistent with the findings of Andrews and Withey (1976) who also examined the relationship between satisfaction with self and perceived QOL. Campbell et al. (1976), who did not examine this relationship, nonetheless, recognized this as an oversight when they suggest "if we had constituted a domain of the 'self' it would undoubtedly figure as one of our most important in determining overall well-being" (1976, p. 363).

In a bivariate analysis, Andrews and Withey (1976) found that of a large number of life domains examined, the strongest effect on QOL (measure by the Life 3 Scale) was due to the satisfaction with self measures. In contrast to the present study, satisfaction with family had a greater effect on perceived QOL than satisfaction with health. Satisfaction with friends was about as predictive as satisfaction with health. However, in the present study it is clearly the least important predictor of perceived QOL.

In a multivariate analysis using 12 selected predictors, Andrews and Withey (1976) found that the most significant effects on QOL were related to the concept of self, family, money, housing, and fun. They explained that satisfaction with health was less predictive of QOL because their cross-sectional survey samples consisted of American adults outside of institutions who were generally in good physical and mental health with most of their basic physical needs met. Satisfaction with friends was not entered into the equation because of poor predictive power. These 12 life domains accounted for between 50% (May survey) and 62% (November survey) of the variance in QOL (measured by the Life 3 Scale) compared to 81% of the variance in perceived QOL (measured by the SASS) in the present study.

Campbell et al. (1976) found that satisfaction with friends accounted for 13% of the variance in overall QOL. They found that people differed in the premium they placed on having close friends; some expressed high satisfaction with a limited circle of close friends whereas others felt deprived with a large network of friends. Similarly, many of the CABG surgical patients reported a high satisfaction with having very few close friends. Nonetheless, satisfaction with friends had little impact on perceived QOL.

Campbell et al. (1976) found that, as a general rule, the strength of the relationships between specific life domains and overall QOL was jointly governed by two related factors: the scope of the domain and its apparent centrality in the respondent's current life situation. This line of thinking might explain why, in a random sample of Americans in the early 1970s, satisfaction with family accounted for 28% of the variance in overall QOL while satisfaction with health accounted for only 8% of the variance. As Campbell et al. (1976) suggest "It is likely that for the considerable majority of the population free of any history of chronic health impairments or the multiplication of difficulties that occur in old age, the simple fact of adequate health is largely taken for granted" (p. 71).

Campbell et al. (1976) found that satisfaction with health had a stronger link to SWB for older respondents than for younger. Because CABG surgical patients are generally an older group of individuals and because health is an immediate, intrusive concern, it is a central domain affecting perceptions of QOL. Satisfaction with family or friends is of less immediate importance in determining QOL for these respondents than is satisfaction with their health.

Campbell et al. (1976) found that feelings of satisfaction in the domains that they extensively examined (housing and neighbourhood) appeared to be tightly bound to the gap between estimates of the current situation and aspiration levels. Moreover, they offered some evidence that aspirations become adjusted to reality as witnessed by the low aspiration levels of the poorly educated and the progressive shrinkage of aspirations with aging.

One can reasonably postulate that the low satisfaction with health (compared to the other life domains examined) reported by the CABG surgical patients is a function of their high aspiration for a complete recovery from the surgical event and their current early phase of the postoperative recovery period. While aspiration levels might well adjust to reality, as Campbell et al. (1976) suggest, "they only do so slowly and in the rather long term". Thus, these patients are unlikely to have accommodated to believing their current health status would remain static. In time, if the adverse circumstances of recovering from surgery persisted, then aspiration levels would likely decrease, progressively removing some of the original decline in satisfaction levels.

The Effects of The Life Domain Satisfactions On Perceived QOL

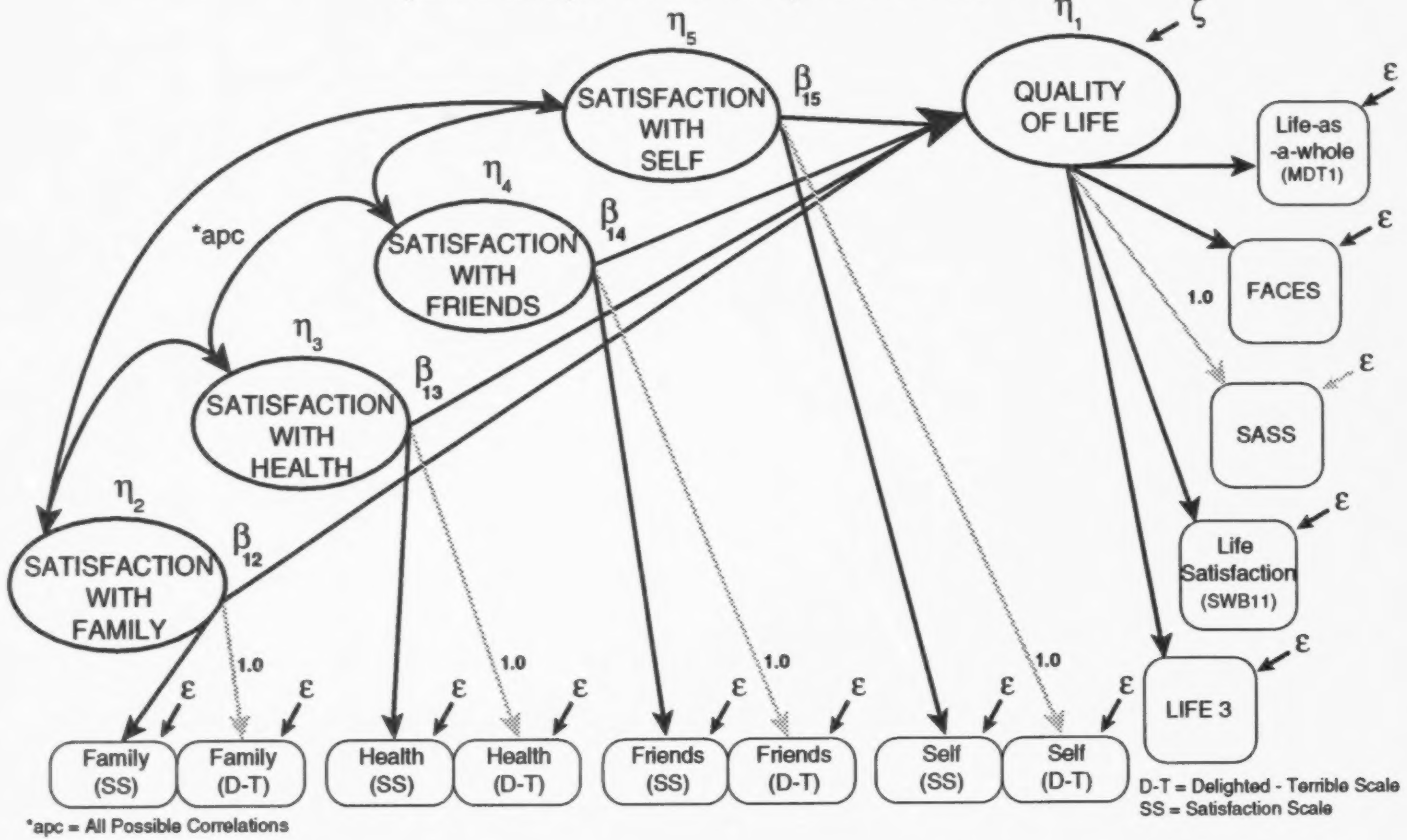
The Delighted-Terrible Scale

This section briefly examines the D-T Scale Model where the life domain satisfaction concepts are scaled to the D-T Scale items rather than to the Satisfaction Scale items by fixing the lambda coefficient connecting the concepts to the D-T Scale items at a value of 1.0 (see Figure 7.4). All other specifications of this model are identical to the Satisfaction Scale Model. The overall fit of the basic D-T Scale Model is almost identical to the initial fit of the Satisfaction Scale Model.

Because the necessary revisions to the D-T Scale Model are identical to those required by the Satisfaction Scale Model (see Table 7.8) only the final model is discussed. With 49 degrees of freedom, the chi square for the final D-T Scale Model is 42.92 ($p=0.717$). The squared multiple correlation (SMC) for the QOL concept is 0.810 and the GFI is 0.979. The maximum likelihood estimates for this model are provided in Table 7.10 and are illustrated in Figure 7.5.

In the D-T Scale Model, the three life domain satisfaction concepts which have a statistically significant effect on perceived QOL are the same as those in the Satisfaction Scale Model. In fact, all of the same estimated coefficients are statistically significant in both models. Satisfaction with friends is the only concept which has an insignificant and negative effect on perceived QOL. The D-T

Figure 7.4 THE EFFECTS OF LIFE DOMAIN SATISFACTIONS ON QUALITY OF LIFE (D-T Scale): Parameter Specifications


η1
ζ
QUALITY OF LIFE
η5
SATISFACTION WITH SELF
β15
η4
SATISFACTION WITH FRIENDS
β14
η3
SATISFACTION WITH HEALTH
β13
η2
SATISFACTION WITH FAMILY
β12
*apc
1.0
ε
Family (SS)
Family (D-T)
Health (SS)
Health (D-T)
Friends (SS)
Friends (D-T)
Self (SS)
Self (D-T)
Life-as -a-whole (MDT1)
FACES
SASS
Life Satisfaction (SWB11)
LIFE 3

*apc = All Possible Correlations

D-T = Delighted - Terrible Scale
SS = Satisfaction Scale

Table 7.10 Maximum Likelihood Estimates: The Effects of Life Domain Satisfactions On Quality of Life (D-T Scale)

Lambda Coefficients

	QOL	FAMILY	HEALTH	FRIENDS	SELF
MDT1	.675*				-.397*
Faces	.538*				
SASS	1.0				
SWB11	.598*				
Life 3	.527*				
FAMILY (SS)		1.706*			
FAMILY (DT)		1.0	.140*		
HEALTH (SS)			1.021*		
HEALTH (DT)			1.0		
FRIENDS (SS)				1.332*	
FRIENDS (DT)				1.0	
SELF (SS)					1.315*
SELF (DT)					1.0

Beta Coefficients

	QOL	FAMILY	HEALTH	FRIENDS	SELF
QOL		.306*	.536*	-.150	.941*

PSI Variance

	QOL	FAMILY	HEALTH	FRIENDS	SELF
QOL	.269*				
FAMILY		.485*			
HEALTH		.221*	.987*		
FRIENDS		.302*	.299*	.500*	
SELF		.278*	.296*	.248*	.473*

Measurement Error Variance

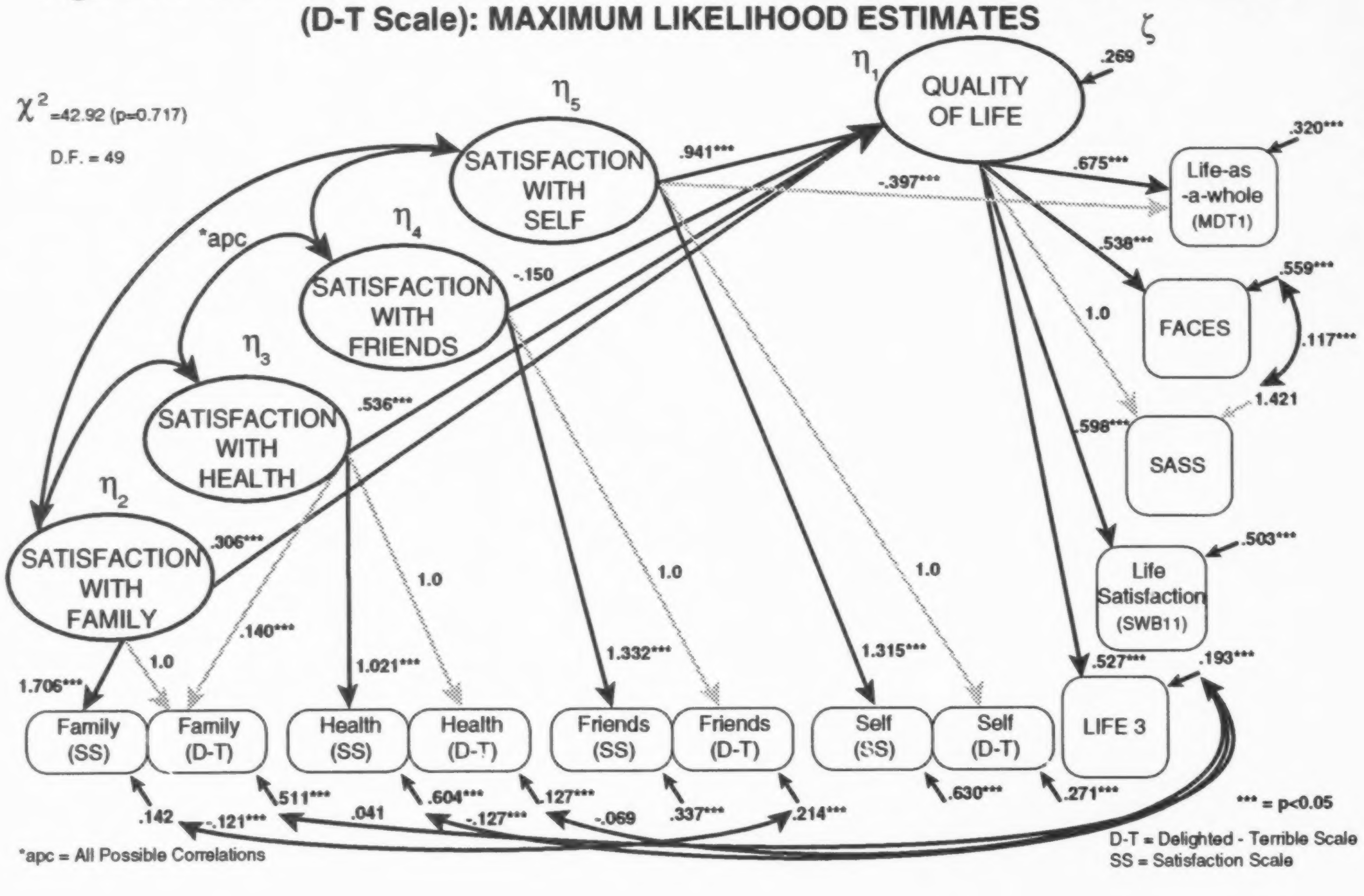
	MDT1	Faces	SASS	SWB11	Life 3	FAMILY	FAMILY	HEALTH	HEALTH	FRIENDS	FRIENDS	SELF	SELF
MDT1	.320*												
Faces		.559*											
SASS		.117*	1.421										
SWB11				.503*									
Life 3					.193*								
FAMILY (SS)						.142							
FAMILY (DT)					.041		.511*						
HEALTH (SS)					-.127*			.604*					
HEALTH (DT)					-.069*				.127*				
FRIENDS (SS)										.337*			
FRIENDS (DT)						-.121*					.214*		
SELF (SS)												.630*	
SELF (DT)													.271*

n=306 * = P<0.05

SS = Satisfaction Scale

DT = Delighted-Terrible Scale

Figure 7.5 THE EFFECTS OF LIFE DOMAIN SATISFACTIONS ON QUALITY OF LIFE (D-T Scale): MAXIMUM LIKELIHOOD ESTIMATES


ζ
.269
η1
QUALITY OF LIFE
χ^2 =42.92 (p=0.717)
D.F. = 49
η5
SATISFACTION WITH SELF
η4
SATISFACTION WITH FRIENDS
η3
SATISFACTION WITH HEALTH
η2
SATISFACTION WITH FAMILY
*apc
.941***
-.397***
-.150
.536***
.306***
.675***
.538***
1.0
.598***
.527***
.320***
Life-as -a-whole (MDT1)
.559***
FACES
.117***
1.421
SASS
.503***
Life Satisfaction (SWB11)
.193***
LIFE 3
1.706***
1.0
.140***
1.021***
1.0
1.332***
1.0
1.315***
1.0
Family (SS)
Family (D-T)
Health (SS)
Health (D-T)
Friends (SS)
Friends (D-T)
Self (SS)
Self (D-T)
.142
-.121***
.511***
.041
.604***
-.127***
.127***
-.069
.337***
.214***
.630***
.271***
*** = p<0.05
*apc = All Possible Correlations
D-T = Delighted - Terrible Scale
SS = Satisfaction Scale

Scale Model and the Satisfaction Scale Model both account for 81% of the variance in perceived QOL. The standardized solution for the estimated coefficients of both models are identical.

Measurement Error of the Life Domain Satisfaction Indicators

Given that the chi square, the degrees of freedom, and standardized estimates of the Satisfaction Scale Model and the D-T Scale Model are identical, an examination of the measurement error variance of both sets of indicators was undertaken to determine if one set was more reliable than the other. Table 7.11 clearly shows that the values of the estimated measurement error variances of both sets of indicators are identical for both the models.

Overall, the D-T Scale indicators have a somewhat smaller percentage of measurement error variance than the Satisfaction Scale indicators. The measurement error variance of the D-T Scale indicators is lower than the Satisfaction Scale indicators for the concepts of satisfaction with health and satisfaction with self. However, the D-T Scale indicator has a much greater percentage of measurement error variance than the Satisfaction Scale indicator for the concept of satisfaction with family. The measurement error variance for both indicators of the concept of satisfaction with friends are about the same. Therefore, there is no reason to prefer one set of indicators over the other.

Table 7.11 Measurement Error Variance of Indicators

	Satisfaction Scale Model	D-T Scale Model
QOL Indicators		
MDT1	.320 (46.4%)	.320 (46.4%)
Faces	.559 (55.8%)	.559 (55.8%)
SASS	1.421 (50.0%)	1.421 (50.0%)
SWB11	.503 (49.9%)	.503 (49.9%)
Life 3	.193 (33.0%)	.193 (33.0%)
Satisfaction with Family Indicators		
Satisfaction Scale	.142 (9.1%)	.142 (9.1%)
D-T Scale	.511 (47.4%)	.511 (47.4%)
Satisfaction with Health Indicators		
Satisfaction Scale	.604 (37.1%)	.604 (37.1%)
D-T Scale	.127 (11.4%)	.127 (11.4%)
Satisfaction with Friends Indicators		
Satisfaction Scale	.337 (27.5%)	.337 (27.5%)
D-T Scale	.214 (29.9%)	.214 (29.9%)
Satisfaction with Self Indicators		
Satisfaction Scale	.630 (43.5%)	.630 (43.5%)
D-T Scale	.271 (36.5%)	.271 (36.5%)

Summary

This chapter presents the effects of the satisfaction with four domains of life on perceived QOL. Two LISREL models are examined: The Satisfaction Scale Model and The D-T Scale Model. The former model scales the four satisfaction with life domain concepts to the respective indicators on the Satisfaction Scale. The latter model scales the satisfaction with life domain concepts to the D-T Scale indicators.

Of the four domains of life examined, CABG surgical patients are most satisfied with their family life and least satisfied with their health. Descriptive statistics reveal that the Satisfaction Scale produces slightly more skewed score distributions than the D-T Scale. The correlations of the two items measuring the same domain of life demonstrate a stronger correlation with each other than with the indicators of the other life domain satisfaction variables.

The initial analysis of both the Satisfaction Scale Model and the D-T Scale Model indicate significant discrepancies between the model-implied covariances and the data covariances. Seven identical data-driven model changes were implemented in both models to gain an adequate fit with the data. An negative direct effect from the concept satisfaction with self to the QOL indicator MDT1 is required to counteract the strong indirect effect to the other QOL indicators. This threatens the construct validity of the concept QOL because the MDT1 indicator is behaving inconsistent with the other four indicators of QOL in the context of this model. Moreover, the multiple correlated measurement error variances involving the QOL indicator Life 3 leads one to question the functioning of this indicator as well. This indicator was also problematic in both Chapter V and Chapter VI.

The final LISREL analyses of both models exhibit identical standardized estimates and chi square statistics. The effects of the satisfaction with life domain concepts on perceived QOL are identical in both models. The concepts satisfaction with family, with health, and with self demonstrate statistically significant effects on QOL. The unexpectedly negative effect of the concept satisfaction with friends on perceived QOL is not statistically significant and this is likely a mere sampling fluctuation around a true zero effect.

The estimates of measurement error variance are identical for all indicators in both models. The D-T Scale responses have slightly less measurement error variance in general. However, the effect on the fit of the model is inconsequential. Therefore, either the Satisfaction Scale indicators or the D-T Scale indicators are adequate as measures of their respective life domain satisfaction concepts.

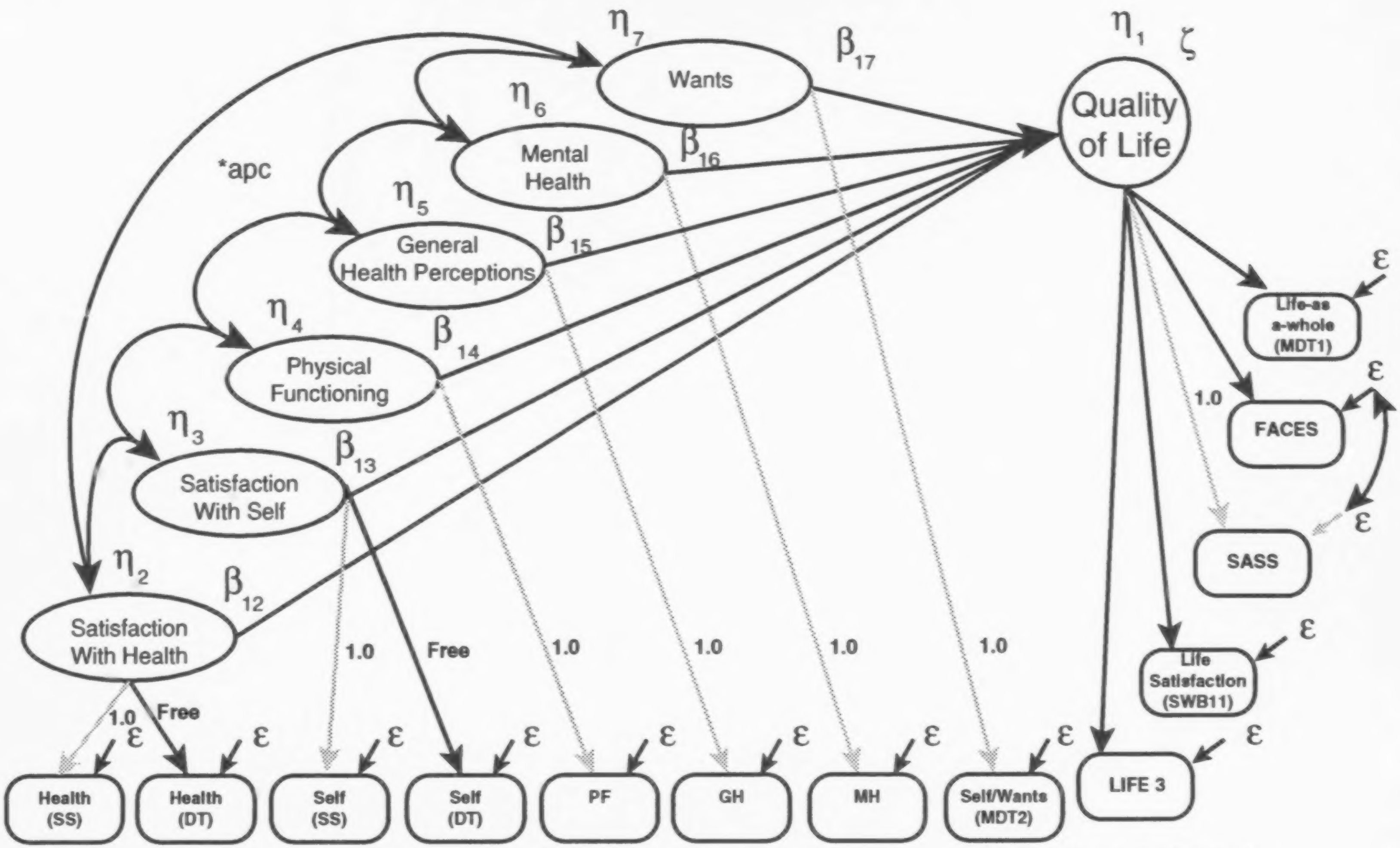
One might consider in the future evaluating two separate models each with single indicators (D-T Scale or Satisfaction Scale) for the satisfaction with life domain concepts. One would have to acknowledge the need for fixed measurement error variances of the indicators of these concepts which could potentially change the meaning of the concepts. Consequently, these concepts could provide stronger or weaker effects on QOL. In this context one must select criteria in addition to measurement error to evaluate the indicators.

VIII. COMBINING THE BEST COMPONENTS OF THE PRIOR MODELS OF QUALITY OF LIFE

There must be redundancy among the components of the models of the predictors of Quality of Life (QOL) discussed in Chapters V through VII because they cumulatively account for more than 100% of the variance of QOL. Specifically, the model of the eight dimensions of health accounts for 66.5% of the variance in QOL, the Multiple Discrepancies Theory (MDT) concepts account for 88.3% of the variance in QOL, and the life domain satisfaction concepts explain 81% of the variance in QOL for a total exceeding 100% explained variance. Therefore, the following discussion surrounds a model which combines only the most effective predictors of the previous models (hereafter called the Combined Model) to determine which remain effective while controlling for all the other effective components. The objective is to determine which of the previous significant affects appear to be effective merely because they are redundant or correlated with the truly effective sources.

The Combined Model consists of seven concepts discussed in previous chapters: QOL, Satisfaction with Health, Satisfaction with Self, Physical Functioning, General Health Perceptions, Mental Health, and WANTS (see Figure 8.1). The six arrows from these background concepts to QOL are the effects on QOL to be estimated. The WANTS concept from the multiple discrepancies theory (MDT) demonstrated the

Figure 8.1 A COMBINED MODEL OF QUALITY OF LIFE
Parameter Specifications


η_7
Wants
β_{17}
η_1
ζ
Quality of Life
η_6
Mental Health
β_{16}
*apc
η_5
General Health Perceptions
β_{15}
η_4
Physical Functioning
β_{14}
η_3
Satisfaction With Self
β_{13}
η_2
Satisfaction With Health
β_{12}
1.0
Free
1.0
Free
1.0
1.0
1.0
1.0
1.0
ε
Health (SS)
Health (DT)
Self (SS)
Self (DT)
PF
GH
MH
Self/Wants (MDT2)
LIFE 3
Life Satisfaction (SWB11)
SASS
FACES
Life-as a-whole (MDT1)

*apc = All Possible Correlations

DT = Delighted - Terrible Scale
SS = Satisfaction Scale

strongest effect on QOL in Chapter VI. The Physical Functioning, General Health Perceptions, and Mental Health concepts of the SF-36 health survey were the three which demonstrated a diversity of statistically significant effects on QOL in Chapter V. The Satisfaction with Health and Satisfaction with Self concepts were two concepts which were most predictive of QOL in the models discussed in the last chapter.

The QOL concept continues to have the same five indicators: the life-as-a-whole item from the MDT, the Faces Scale, the Self-Anchoring Striving Scale (SASS), the Life Satisfaction item (SWB11) of the Index of Well-Being (IWB), and the Life 3 Scale. The QOL concept is scaled to the SASS indicator. The SASS indicator is assigned a fixed measurement error variance of 50% of the total observed variance.

The Satisfaction with Health concept has two indicators, and is scaled to the Satisfaction Scale item by fixing the lambda at 1.0 while the lambda coefficient for the Delighted-Terrible (D-T) Scale item is free to be estimated. The Satisfaction with Self concept is also measured by two indicators, and is similarly scaled to the Satisfaction Scale item while the lambda coefficient to the D-T Scale item is free to be estimated. The measurement error variances of these four indicators are free to be estimated.

The Physical Functioning, General Health Perceptions, and Mental Health concepts are measured by the respective subscale scores of the SF-36 health survey. The lambda coefficient between the three concepts and their respective indicators is fixed at 1.0 to ensure that each unit change in the concept results in a corresponding unit change in the indicator. As before, the measurement error variance for the physical functioning and the general health perceptions indicators are fixed at 30% of their total observed variance, and the error variance of the mental health indicator is fixed at 20% of the total observed variance.

Maximum Likelihood Estimates

The maximum likelihood estimates for the Combined Model of QOL are found in Table 8.1 and illustrate in Figure 8.2. All of the estimated lambda coefficients are statistically significant. Only two of the beta coefficient estimates are statistically significant, the largest of which is the effect of the WANTS concept on QOL (standardized beta=0.461). Each unit increase in the respondents' assessment of the discrepancy between what they have and what they want increases their QOL assessment by 0.744 units. This is an impressive finding because it suggests that the concept WANTS remains a strong predictor of QOL even while controlling for all the significant portions of the previous models of predictors of QOL.

The second statistically significant effect on QOL comes from the concept Satisfaction with Self (standardized beta=0.320). A unit increase in the concept Satisfaction

Table 8.1 Maximum Likelihood Estimates of the Combined Model of Quality of Life

Lambda Coefficients

	QOL	Health	Self	PF	GH	MH	WANTS
MDT1	.488*						
Faces	.546*						
SASS	1.0						
SWB11	.593*						
Life 3	.505*						
Health (SS)		1.0					
Health (DT)		.923*					
Self (SS)			1.0				
Self (DT)			.748*				
Physical Function				1.0			
General Health					1.0		
Mental Health						1.0	
Self/wants							1.0

Beta Coefficients

	QOL	Health	Self	PF	GH	MH	WANTS
QOL		.182	.422*	-.005	.006	.012	.744*
Health							
Self							
Physical Function							
General Health							
Mental Health							
WANTS							

PSI

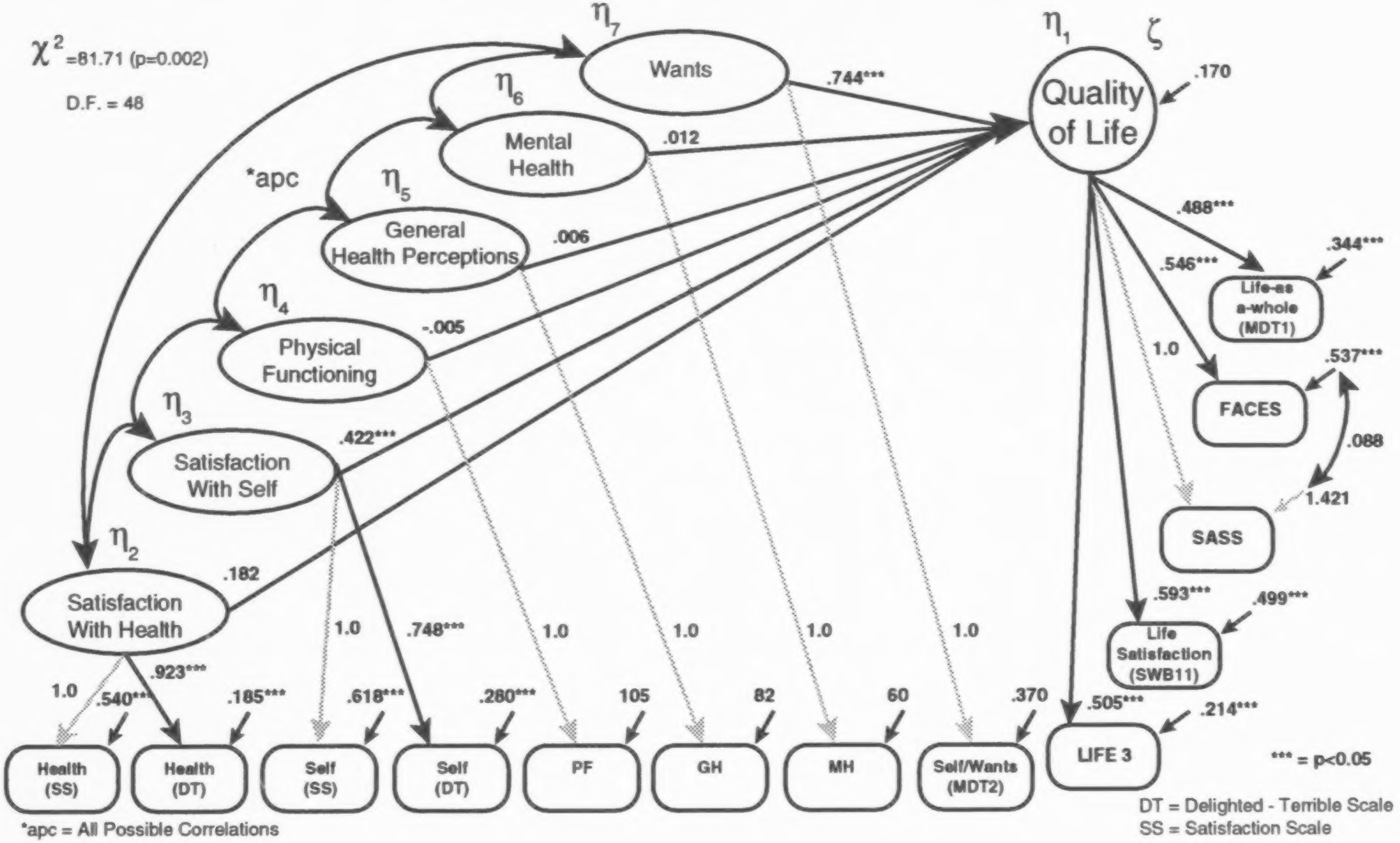
	QOL	Health	Self	PF	GH	MH	WANTS
QOL	.170						
Health		1.087					
Self		.431	.830				
Physical Function		6.423	1.505	244.483			
General Health		11.156	4.017	122.077	190.818		
Mental Health		8.324	6.251	96.015	126.442	239.900	
WANTS		.450	.429	2.828	4.757	6.962	.555

Measurement Error Variance

	MDT1	Faces	SASS	SWB11	Life 3	Health	Health	Self	Self	PF	GH	MH	Self/wants
MDT1	.344*												
Faces		.537*											
SASS		.088	1.421										
SWB11				.499*									
Life 3					.214*								
Health (SS)						.540*							
Health (DT)							.185*						
Self (SS)								.618*					
Self (DT)									.280*				
Physical Function										104.8			
General Health											81.8		
Mental Health												59.9	
Self/wants													.370

n=306 * = p<0.05

Figure 8.2 A COMBINED MODEL OF QUALITY OF LIFE
Maximum Likelihood Estimates


χ^2 =81.71 (p=0.002)
D.F. = 48
*apc
η_7
Wants
η_6
Mental Health
η_5
General Health Perceptions
η_4
Physical Functioning
η_3
Satisfaction With Self
η_2
Satisfaction With Health
η_1
ζ
Quality of Life
.170
.744***
.012
.006
-.005
.422***
.182
.488***
.546***
1.0
.593***
.505***
.344***
Life-as a-whole (MDT1)
.537***
FACES
.088
1.421
SASS
.499***
Life Satisfaction (SWB11)
.214***
LIFE 3
1.0
.540***
.923***
.185***
1.0
.618***
.748***
.280***
1.0
105
1.0
82
1.0
60
1.0
.370
Health (SS)
Health (DT)
Self (SS)
Self (DT)
PF
GH
MH
Self/Wants (MDT2)
*** = p<0.05
*apc = All Possible Correlations
DT = Delighted - Terrible Scale
SS = Satisfaction Scale

with Self is expected to be accompanied by a 0.422 unit increase in the WANTS concept. The Mental Health concept nearly reaches statistical significance but the remaining concepts in the model fail to reach statistical significance.

The concepts in the model (primarily WANTS and Satisfaction with Self) explain 88% of the variance in QOL, despite rather low standardized solution slopes, because the covariance between the concept Satisfaction with Self and the concept WANTS corresponds to a high correlation (0.632). One can conclude, therefore, that in the presence of the two truly effective predictor concepts of QOL, WANTS and Satisfaction with Self, there is no evidence for the previous separate effectiveness of the other concepts in the model because their effectiveness was apparent only because they correlated with, or overlapped with, the two effective predictors which were not present in those models. That is, the effectiveness of predictor concepts in previous chapters is illusory.

The error variance in the prediction of the QOL concept is contained in the psi matrix. The error variance corresponding to the prediction of QOL is 0.170, which is about 12% of the variance in this concept. Therefore, most (88.3%) of the variance in this concept is accounted for by the WANTS concept and the Satisfaction with Self concept.

For the model illustrate in Figure 8.2 LISREL reports a chi square of 81.71 with 48 degrees of freedom which has probability 0.002. Since the probability of 0.002 exceeds the usual 0.05 criteria, the conclusion is to reject that the differences between the model-implied covariance matrix and the observed covariance matrix are small enough to be sampling fluctuation.

The Standardized Residuals

Examining the residuals is useful in searching for why the Combined Model failed. Standardized residuals are estimates of the number of standard deviations the observed residuals are away from the zero residuals that would be provided by a perfectly fitting model (Hayduk, 1987). Positive residuals represent under-predicted covariances and negative residuals represent over-predicted covariances. The residuals reveal the elements of the data matrix that are poorly reproduced by the model-implied covariance matrix.

A detailed inspection of the standardized residuals for the Combined Model reveals that no one specific modification would solve the discrepancies between the model-implied covariances and the observed covariances (see Table 8.2). The residuals are not individually large but the pattern is consistent. Some residuals are positive and some are negative representing over- and underestimated covariances. Large positive or negative residuals suggest that some model constraints, if freed, would permit the model to better match the data. The omission or inclusion of one parameter, however, can be felt in more than one covariance element.

Table 8.2 Standardized Residuals For The Combined Model Of Quality of Life

	MDT1	Faces	SASS	SWB11	Life 3	Health	Health	Self	Self	PF	GH	MH	Self/wants
MDT1	-.000												
Faces	-.461	-.001											
SASS	.186	-.016	-.117										
SWB11	-.306	-.042	-.751	.000									
Life 3	.487	-.245	.086	.436	-.000								
Health (SS)	-.035	.288	.583	-.611	-1.602	-.000							
Health (DT)	.849	.530	.387	.302	-.548	-.000	-.000						
Self (SS)	-1.179	.094	-.067	.525	.226	1.003	.078	.000					
Self (DT)	-1.365	.557	.335	.676	.121	.180	-.521	.000	.000				
Physical Function	1.017	.339	1.665	-.627	-1.424	.135	-.060	-.649	.549	.000			
General Health	1.035	-.143	1.600	-.631	-1.144	.450	-.196	.241	-.203	.000	.000		
Mental Health	.118	.632	-.290	.023	-.222	-.754	.333	-.483	.407	.000	.000	.000	
Self/wants	.618	-.225	.177	-.359	-.159	-.385	.170	.244	-.205	.000	.000	.000	.000

n=306

Examining the rows of Table 8.2 one finds the first large negative residual (-1.602) between the Satisfaction with Health indicator (Satisfaction Scale) and the Life 3 Scale. That is, the covariance with the Life 3 Scale is over-predicted. In row 8 one encounters two discrepancies, both involving the Satisfaction with Self indicator (Satisfaction Scale). The first discrepancy is associated with the MDT1 item (-1.179), and the second, with the Satisfaction with Health indicator (Satisfaction Scale) (1.003). In row 9 one finds another negative residual (-1.365) between the indicator of Satisfaction with Self (D-T Scale) and the MDT1. The two residuals between the Satisfaction with Self indicators and the MDT1 are consistent with the finding of Chapter VII where a coefficient between the concept Satisfaction with Self and the MDT1 was necessary. In the context of the model which includes the concept Satisfaction with Self, the MDT1 indicator of QOL is not behaving consistently with the other QOL indicators.

In rows 10 and 11, one finds several substantial residuals involving the indicators of the Physical Functioning and the General Health Perceptions concepts and both the MDT1 and the SASS and negative residuals with the Life 3 Scale. One would expect that if the Physical Functioning and General Health Perceptions concepts, and hence, these indicators, were removed from the model, these residuals would disappear and the model would improve. This was, in fact, tried and the chi square of the model improved to 71.67 (p=0.003) with 42 degrees of freedom when the Physical Functioning concept was removed. It improved further to 50.38 (p=0.056) when the General Health Perceptions concept was also removed. When the last health concept in the model, Mental Health, was removed, the chi square of the model improved to 45.70 (p=0.033) with 30 degrees of freedom. However, disturbing residuals involving the MDT1 and the Life 3 Scale persisted because these residuals were not in any of the eliminated row or columns of the data covariance matrix.

These model revisions were reversed to maintain the integrity of the original Combined Model. The three health concepts were put back in the Combined Model. It is important to demonstrate the ineffectiveness of these concepts and this demonstration is lost if the concepts are removed.

Any residual in the first 5 columns of the residual matrix leads one to question the validity of the QOL concept. The construct-related validity is threatened especially in the context of the two health concepts, Physical Functioning and General Health Perceptions. The unidimensionality of the QOL concept falls apart to some extent when challenged with these external causal forces. The QOL indicators, the MDT1 and the Life 3 Scale are most problematic and reveal inconsistencies with the physical functioning and general health perceptions indicators. These health concepts also exhibit inconsistencies with the SASS indicator.

In previous chapters the QOL indicators were judged as adequate given the number of times they could have, but did not, fail as indicators when up against the many challenges in the context of a variety of models. These indicators have largely behaved in congruence with one another in most, but not all, models. When inconsistencies appeared, no one indicator was implicated in all contexts.

Therefore, the Combined Model fails in ways that indicate a variety of problems with the measurement of QOL and the variety of locations in which the problems appear indicate that no single, or few, changes to the model's coefficients are likely to produce a well fitting model. Dropping the health concepts from the model improves the chi square considerable but fails to provide an adequate solution for the inconsistencies with the three problematic indicators of QOL: the MDT1, the SASS, and the Life 3 Scale. This improvement is illusory, however, because it merely amounts to an unwillingness to face the large residuals in the corresponding rows of the residual matrix.

Model Revisions

The Combined Model fails, though not in the extreme, thereby indicating primarily problems in the measurement of QOL. It is unclear how best, or even if one can, solve the problems. The maximum modification index for the original model is 12.93. That is, the chi square would be expected to decrease by 12.93 if the corresponding coefficient was freed.

To put this in context, one uses the fact that the mean of a chi square distribution is its degrees of freedom (the degrees of freedom for this model are 48) and the variance of a chi square distribution is equal to two times the degrees of freedom. Therefore, the variance = 2 x 48 = 96 and the standard deviation is 9.8. Hence, the chi square statistic for this model (81.71) is over three standard deviations away from the mean of the chi square distribution and it would take three non-redundant modifications, each providing a chi square improvement of about 10, to obtain an adequate fit of this model with these data (a chi square value near the mean and hence whose probability is about 0.5). Given that the maximum modification index, the expected chi square change, is only 12.93, and that all the other modification indices are smaller and possibly redundant with this, it is unlikely that one could find an acceptable model; an attempt is, nonetheless, made.

The first of only two data-driven model revisions involves adding a lambda coefficient to be estimated between the Satisfaction with Self concept and the QOL indicator MDT1. When estimated, this coefficient (-0.370) is statistically significant ($t=-3.227$, $p<0.05$). The chi square improves to 61.93 ($p=0.025$) with 47 degrees of freedom. This same coefficient was necessary for an adequate fit of the model in Chapter VII.

The second model revision involves freeing a lambda coefficient between the General Health Perceptions concept and the Life 3 indicator of QOL. When estimated, this coefficient (-0.011) is statistically significant (t=-2.832, p<0.05). This same coefficient was required in Chapter V when all eight of the health dimensions were used to predict QOL.

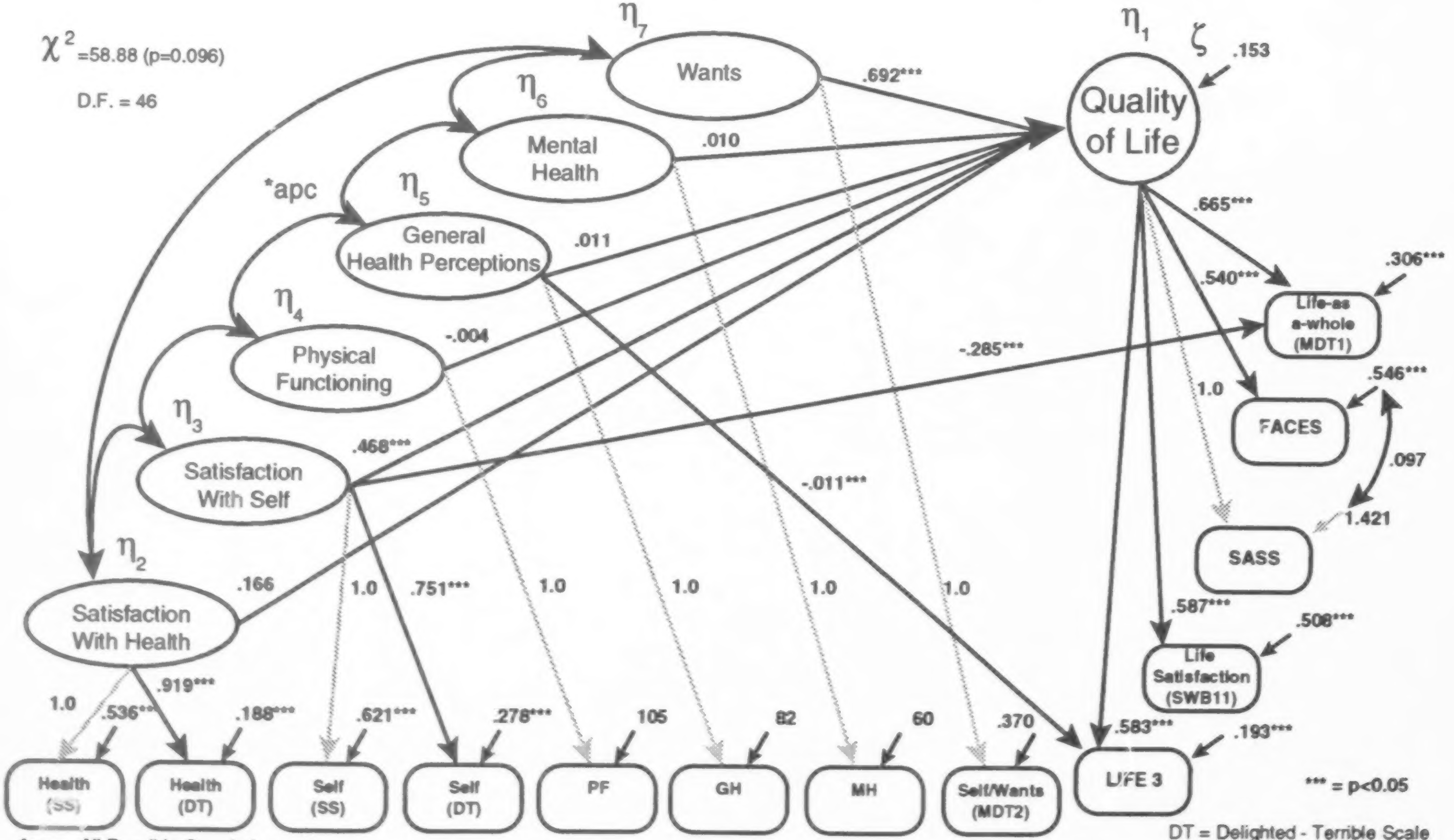
The chi square of the final Combined Model is 58.88 (p=0.096) with 46 degrees of freedom (see Figure 8.3). This is still a considerable distance from a good chi square probability but the modification indices are too small to suggest that a few changes will improve matters quickly.

The SMC for the QOL concept is 0.895. That is, 89.5% of the variance of QOL is accounted for by the concepts in the model. When the fixed measurement error variance of the indicators was reduced by 50% and then by 75%, the SMC of QOL was subsequently reduced to 85.7% and 84.6%, respectively. Therefore, one is reassured that the original 89.5% explained variance in QOL is not an artifact of overly large proportions of fixed measurement error variance. Only two of the concepts, WANTS (standardized beta=0.428) and Satisfaction with Self (standardized beta=0.353), have a statistically significant affect on QOL (see Table 8.3). These two concepts remain effective predictors of QOL even while controlling for the effective components of the previous models.

Summary

This chapter presents a model combining the effective components of all previous models which attempted to account

Figure 8.3 A COMBINED MODEL OF QUALITY OF LIFE
Maximum Likelihood Estimates


η7
Wants
.692***
η6
Mental Health
.010
*apc
η5
General Health Perceptions
.011
η4
Physical Functioning
-.004
η3
Satisfaction With Self
.468***
η2
Satisfaction With Health
.166
η1
ζ
.153
Quality of Life
.665***
.540***
1.0
.587***
.583***
-.285***
-.011***
.306***
Life-as a-whole (MDT1)
.546***
FACES
.097
1.421
SASS
.508***
Life Satisfaction (SWB11)
.193***
LIFE 3
1.0
.536***
.919***
.188***
1.0
.621***
.751***
.278***
1.0
105
1.0
82
1.0
60
1.0
.370
Health (SS)
Health (DT)
Self (SS)
Self (DT)
PF
GH
MH
Self/Wants (MDT2)

χ^2 =58.88 (p=0.096)

D.F. = 46

*apc = All Possible Correlations

*** = p<0.05

DT = Delighted - Terrible Scale
SS = Satisfaction Scale

Table 8.3 Maximum Likelihood Estimates of the Combined Model of Quality of Life

Lambda Coefficients

	QOL	Health	Self	PF	GH	MH	WANTS
MDT1	.665*		-.285*				
Faces	.540*						
SASS	1.0						
SWB11	.587*						
Life 3	.583*				-.011*		
Health (SS)		1.0					
Health (DT)		.919*					
Self (SS)			1.0				
Self (DT)			.751*				
Physical Function				1.0			
General Health					1.0		
Mental Health						1.0	
Self/wants							1.0

Beta Coefficients

	QOL	Health	Self	PF	GH	MH	WANTS
QOL		.166	.468*	-.004	.011	.010	.692*
Health							
Self							
Physical Function							
General Health							
Mental Health							
WANTS							

PSI

	QOL	Health	Self	PF	GH	MH	WANTS
QOL	.153						
Health		1.091					
Self		.433	.827				
Physical Function		6.442	1.448	244.483			
General Health		11.232	4.122	124.107	190.046		
Mental Health		8.338	6.330	96.015	125.781	239.900	
WANTS		.451	.423	2.828	4.814	6.962	.555

Measurement Error Variance

	MDT1	Faces	SASS	SWB11	Life 3	Health	Health	Self	Self	PF	GH	MH	Self/wants
MDT1	.306*												
Faces		.546*											
SASS		.097	1.421										
SWB11				.508*									
Life 3					.193*								
Health (SS)						.536*							
Health (DT)							.188*						
Self (SS)								.621*					
Self (DT)									.278*				
Physical Function										104.8			
General Health											81.8		
Mental Health												59.9	
Self/wants													.370

n=306 * = $p<0.05$

for the variance in QOL. The model fails in ways similar to all previous models. Noticeable inconsistencies with the measurement structure of QOL, which appear depending on the context of the rest of the model, remain. Problems with the QOL indicators, the Life 3 Scale and the MDT1, have been a recurring one. The Life 3 Scale defies the proportionality constraints of the QOL concept in the presence of the health concepts and the MDT1 misbehaves in the presence of the Satisfaction with Self concept. The Combined Model reveals the same ill-fit as the previous models because the same covariances are involved in all these models. The residuals point to small but dispersed discrepancies. Even deleting the health concepts from the Combined Model fails to solve all the problems of disproportionality among the QOL indicators.

Though the final Combined Model demonstrates a nearly adequate fit with the data, the lambda coefficients leading to specific QOL indicators still lead one to question the conceptualization of QOL. It is unclear why the QOL indicators are behaving differently depending on the context of the model. The Life 3 Scale works in most contexts but not when challenged to behave consistently towards the General Health Perceptions and Physical Functioning concepts. These inconsistencies presented in the form of residuals and necessary lambda coefficients. Similarly, the MDT1 is generally a good QOL indicator but not when challenged to behave consistently with the Satisfaction with Self concept.

IX. SUMMARY AND CONCLUSIONS

Using a survey design, this study explored the construct-related validity of the concept quality of life (QOL) for 306 CABG surgical patients. A major objective was to evaluate the measurement structure of QOL. This was accomplished by examining several models investigating the internal consistency of QOL and several more models of the predictors of QOL. The predictive models included an assessment of the effects of eight dimensions of perceived health on QOL, an evaluation of the effectiveness of the Multiple Discrepancies Theory (MDT) concepts, and the effects of four life domain satisfactions on QOL. Only the most effective components of these predictive models of QOL were combined and comparatively evaluated in the final model.

The internal consistency of QOL is addressed in Chapter IV and the external consistency of QOL in Chapters V through XIII where the QOL concept is granted meaning both through the links to its indicators and by the links to other concepts. Two major threats to the construct validity of QOL are a common thread throughout the data analyses. The first is the need for systematic direct effects from other concepts to the QOL indicators and the second is the need for correlated measurement error among several indicators of QOL and several indicators of other concepts. These two kinds of coefficients, though not always simultaneously, are required in all of the predictor models analyzed.

In Chapter IV five models representing the measurement of QOL with five single-item indicators are tested. When explored in relation to one another, the multiple indicators of QOL demonstrate evidence of proportionality or internal consistency. A fixed lambda coefficient scales the concept and the SASS indicator to share a common metric. The meaning of the concept is solidly and rigidly established by fixing the measurement error variance of the SASS indicator at 50% of the total observed variance to quantify the gap between the concept and the indicator. The extra precision in specifying meaning of QOL by fixing the lambda coefficient and measurement error to the SASS is rewarded by a savings in degrees of freedom and a tighter, more parsimonious story about the functioning of this set of indicators.

The best fitting model depicts the effects of QOL on Life 1 and Life 2, the two administrations of one instrument, and specifies the mechanism of how the Life 3 Scale is derived -- namely as the mean of Life 1 and Life 2. QOL significantly influences both Life 1 and Life 2, but the effect of the concept Life 1 on Life 2 is not significant. This suggests there is a re-tapping or re-assessment of QOL each time the subjects provide a score on Life 1 and Life 2 and that there are no significant sources of carry-over or consistency directly from Life 1 to Life 2. That is, there is no sign of memory or retest effects in these subjects' reports. From the perspective of just the set of indicators of QOL, there seems to be a subjective re-evaluation that is fundamental to all five indicators of QOL.

The clearest way of providing meaning to a concept is to indicate which of the observed items is most similar to the conceptualization. The commitment to the SASS item as closest to or most similar to the conceptualization of QOL places QOL in the public domain because all can see precisely which part of the shared observable world one attaches to a particular conceptualization of QOL. The global and unidimensional conceptualization of QOL is a function of the investigator's thinking process and the observed search process of the respondents as they answered the items. The meaning of the concept, however, is changed by adjusting the measurement error of the indicator (real world) because different degrees of measurement error strengthen or weaken the connections between the concept and the indicator.

The significant amount of measurement error in all the QOL indicators means that the only way to salvage the global nature of QOL, sufficient to span all the indicators, is to admit that each item is only remotely connected to global QOL. Nonetheless, the indicators demonstrate, with some reservation, acceptable proportionality or internal consistency with each other. The internal consistency of the indicators of QOL is impressive if one considers the very small percentage of failures that actually did occur compared to how many could have and did not. Still, each correlated measurement error or direct effect to a QOL indicator represents a failure and the indicators which were most often challenged are the Life 3 Scale and SWB11. Even in the presence of the many external challenges from the predictor concepts to the proportionality of the indicators, the measurement structure of QOL remains relatively stable.

The relationships between eight dimensions of perceived health and QOL are examined in Chapter V. Aggressive attempts are made to determine a suitable factor structure for the health indicators but no persuasive and interpretable factor solution could be located. This leads to the construction of a LISREL model examining the separate effects of each of the eight health dimensions on QOL. The initial model fails to fit the data but with several data-driven revisions an acceptable model is recovered.

The need for negative direct effects from the General Health Perceptions concept to two of the QOL indicators, the Life 3 Scale and SWB11, is most disturbing because, as mentioned previously, this represents a threat to the validity of these indicators as measures of QOL. Given that the direct effects of General Health Perceptions on these indicators counteracts (is opposite in sign to) the indirect effects via QOL, the net effect of General Health Perceptions on these indicators is nearer to zero than it is for the other indicators of QOL.

Even though the direct effect of the General Health

Perceptions concept on QOL is positive, the total effect of the concept on the Life 3 Scale and SWB11 are essentially zero. This zero total effect on these two indicators and the accompanying positive effect on the QOL concept might reflect an inadequacy in these two indicators compared to the MDT1, the SASS, and the Faces Scale. If these latter three QOL indicators are superior measures of QOL they may be responsible for the effect of the General Health Perceptions concept on QOL. The negative direct effects from the General Health Perceptions concept to the Life 3 Scale and SWB11 are simply functioning to cancel the indirect effects through QOL. That is, these indicators are acting differentially with respect to General Health Perceptions and hence QOL. QOL, as a concept, is unable to account for the full behavior of all the indicators.

The error covariances between the indicators of General Health Perceptions and Bodily Pain and the QOL indicator, the Faces Scale, are equally disturbing because they represent a threat to the internal consistency of QOL. They represent a threat to the internal consistency of QOL because there are systematic influences on the Faces Scale that are not coming from QOL. If Life 3 is truly a good indicator of QOL there should be no need for correlations with the measurement error of any other observed variable. The observed variables the Life 3 Scale, bodily pain, and general health perceptions share some unexplained systematic source of common variance.

Only three of the eight health concepts exhibit a significant effect on QOL (Physical Functioning, General Health Perceptions, and Mental Health). The other five health concepts (Role Functioning-Physical, Bodily Pain, Vitality, Social Functioning, and Role Functioning-Emotional) are either ineffective, or demonstrate such small effects on QOL that they are undetectable. Overall, the eight dimensions of health account for 66.8% of the variance in QOL.

The effects of the various concepts comprising the Multiple Discrepancies Theory (MDT) on QOL are explored in Chapter VI. The MDT posits that QOL is a function of seven perceived discrepancies, the last of which, functions as an integrating discrepancy concept through which all the other discrepancies are funneled and directed on to affect QOL. The initial LISREL model fails because of a collinearity problem between two of the MDT concepts. This problem is solved by reducing the measurement error variance of two indicators. That is, the original assessment of the measurement error of these concepts was admittedly overly pessimistic and reducing the amount of measurement error changed the meaning of the concept. Several theoretical acceptable model modifications, along with a number of purely data-driven revisions, are required to obtain an adequate fit between the model-implied and the data covariances.

The final model requires direct effects from three of the MDT concepts to four of the QOL indicators, again, threatening the validity of these indicators as measures of QOL by breaking down the strict demand for proportionality among the indicators that is made when QOL is represented as the sole source of these indicators. As was evident in Chapter V, the QOL indicators, the Life 3 Scale and SWB11, function contrary to the others in the context of the MDT.

Only two of the six MDT concepts (OTHERS and EXPECTS) have a significant impact on the WANTS concept, the integrating or mediating concept, and together they explain 76.2% of the variance in WANTS. The concept WANTS, in turn, is the source of most of the 88.3% explained variance in QOL.

An especially theoretically appealing component of the MDT is the placement of the WANTS concept as an intervening variable between the other MDT concepts and QOL. Not only is the concept WANTS the strongest predictor of QOL, but also, it creates parsimony at the structural level. That is, all of the other MDT concepts, primarily OTHERS and EXPECTS, are integrated at, and channeled through, the WANTS concept. The WANTS concept is strongly predictive of, but not identical to, the QOL concept. They are not identical concepts because they are separated both by the structural model characteristics and by the natural distinction in the respondents' language or manner of speaking about QOL and WANTS. If the two concepts were identical there would be no need for both the WANTS concept and the QOL concept, but structurally and theoretically they are both important components of the model.

The model of the MDT concepts demonstrates the tightest postulates of all the models examined. While some of the concepts of the theory fail to influence the WANTS concept, the WANTS concept remains impressive both substantively and structurally. The MDT deserves considerable attention in future QOL research. The laborious and meticulous review of the literature was generally of little assistance in guiding this study because most of the published QOL research lacks theoretical guidance. The theoretical strength of the MDT stands firm in the Combined Model (to be discussed shortly) of QOL even in the presence of other significant predictors.

In Chapter VII, the effects of the satisfaction with four life domains, each measured by two equally reliable indicators, on QOL is examined. Once again, the necessity of an effect from the concept satisfaction with self to a QOL indicator, this time the MDT1, is disturbing and difficult to reconcile because this represents yet another threat to the construct validity of the QOL concept. The MDT1 is discordant with the other four indicators of QOL when connected to the concepts of this model. Once again, as in Chapter V, the multiple correlated measurement errors involving the QOL indicator, the Life 3 Scale, leads one to also question the functioning of this indicator.

The four life domain satisfaction concepts in the final model lack the theoretical richness of the MDT, but nonetheless, account for 81% of the variance of QOL. Three concepts which exhibit a significant effect on QOL include satisfaction with health, with family, and with self.

The Combined Model, in Chapter VIII, is constructed to locate the illusory predictors of QOL by confronting them with the truly effective predictors with which they merely correlate and to search for the most predictive concepts of QOL while controlling for the other effective predictors. Because the three previous models of the predictors of QOL would account for more than 100% of the variance of QOL, were they added together, the Combined Model is constructed to ferret out the redundancies implicit in these models. The most effective predictors comprising the Combined Model include: WANTS, Mental Health, General Health Perceptions, Physical Functioning, and Satisfaction with Self.

Of the three models examined in prior chapters, the model of the effects of the MDT concepts on QOL has the greatest theoretical integrity; integrity one would wish to preserve. Fortunately, in Chapter VI a natural fracture or cleavage in the model is discovered whereby the essence of the theory is carried by the WANTS concept. That is, by capitalizing on the fact that the MDT correctly predicts that the concept WANTS functions to integrate and absorb all of the effects of the other MDT concepts, the only real theoretically driven model, one can segment the theory without misspecification by importing just the WANTS concept into the Combined Model of only the effective components of the other two atheoretical models examined.

The Combined Model, consistent with all others, uncovers a recurring problem in the measurement of QOL. Troubling direct effects are required from the General Health Perceptions concept to the QOL indicator, the Life 3 Scale, and from the Satisfaction with Self concept to the MDT1. Further, only two concepts survive the challenge of this model. The WANTS concept and the Satisfaction with Self concept significantly affect the QOL concept. These concepts account for 89.5% of the variance in QOL.

That is, the health concepts fail to demonstrate any predictive ability in the presence of the WANTS concept and only the Satisfaction with Self concept survives in its presence. Specifically, the concepts which had demonstrated predictive effects on QOL in previous models (Mental Health, General Health Perceptions, Physical Functioning, and Satisfaction with Health) were mere artifacts created by these variables being correlated with the real predictors.

Recommendations For Future Study

It is recommended that the study be replicated and cross-validated with other samples of CABG surgical patients and other patient populations. A longitudinal study of QOL beginning when the patient is placed on the waiting list for surgery and continuing through the first postoperative year would be particularly enlightening for determining changes in

QOL over time. One might also explore the possibility of reciprocal relationships between the various concepts, particularly, health, and QOL.

Suppose QOL influences or is a cause of another concept such as physiological health and in turn perceived health. The models outlined in this study would then be misspecified and the estimates biased. Future research could potentially benefit from exploring the possibility of reciprocal effects or feedback loops between QOL and other concepts such as hope and optimism.

Given the commitment to the particular conceptualization of QOL outlined in this study one is forced to admit that the measures contain a significant amount of measurement error. Future QOL research, guided by theoretical work such as the MDT, ought to be directed toward the construction and evaluation of the reliability and validity of both single and multi-item measures of QOL. Single-item measures, such as those of the MDT questionnaire, might be simplified and readministered to a new sample of subjects. Valid and reliable single items may function just as adequately as multi-item scales provided that they are placed in a clear causal structure.

Hundreds of purported QOL measures, most lacking solid theoretical underpinnings, only add to the confusion regarding the conceptualization of QOL. Unless researchers become committed to a conceptualization of QOL there is little hope of ever mastering the measurement of the outcome they seek.

Summary

Quality of life is a concept that is at the forefront of assessing the outcome of CABG surgery. Health care reform in North America and the accompanying financial constraints will demand evaluations of outcomes of surgery which go beyond morbidity and mortality. Without a clear distinction between health outcomes and QOL, program evaluations and recommendations for continuous quality improvement will lack credibility and direction for change and resource allocation.

This study addresses important issues of measurement, conceptualization, prediction, and interpretation of QOL. Without knowledge of how best to describe and measure QOL, the necessary information required by clinician, health care administrators, and government leaders will remain unavailable. It is hoped that this study offers motivation and direction for future pursuits of the conceptualization and measurement of QOL.

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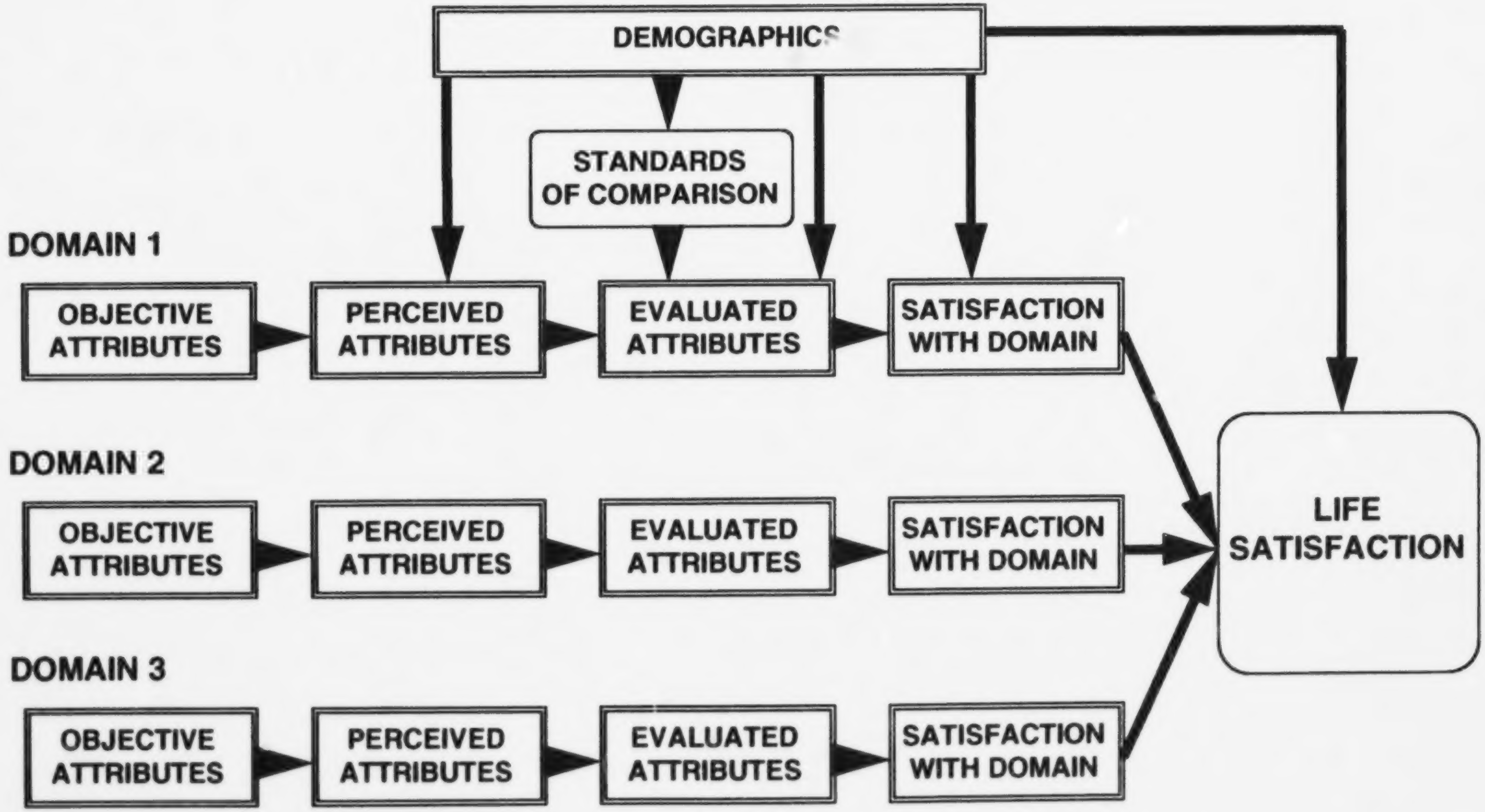
APPENDIX A

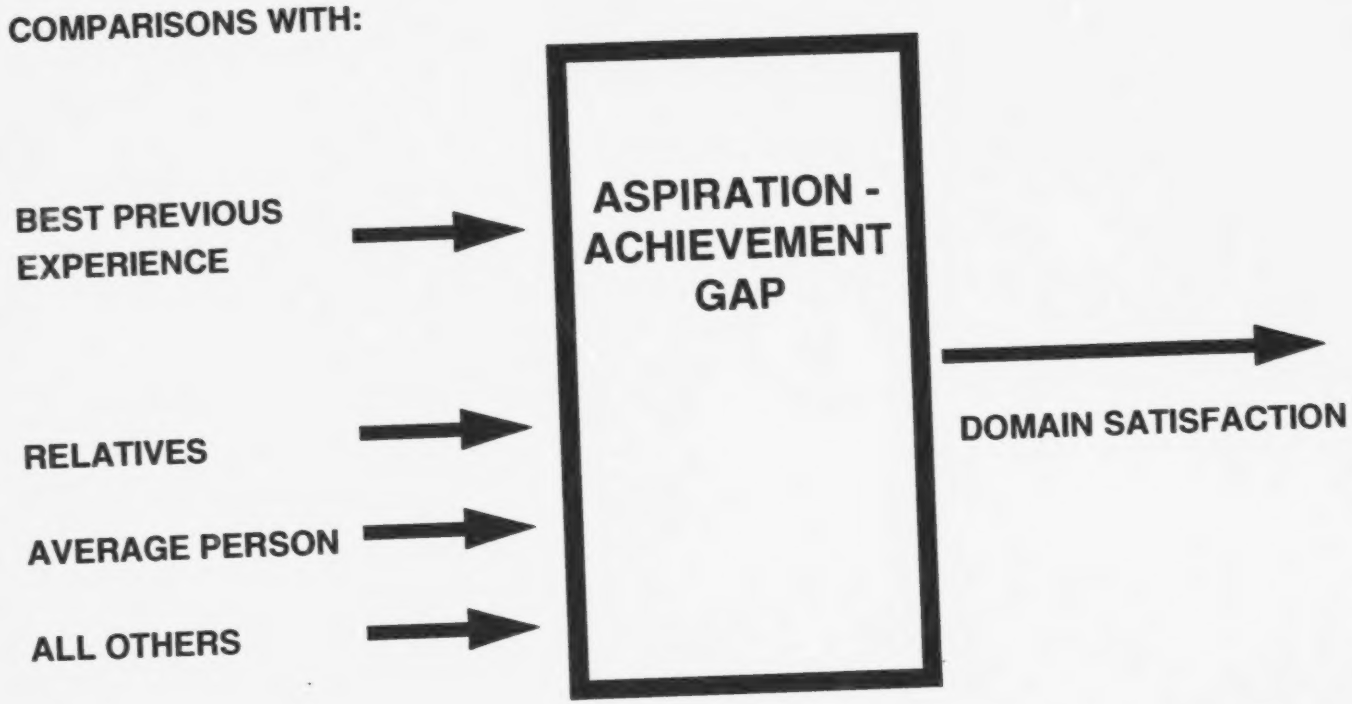
CONCEPTUAL FRAMEWORKS
CAMPBELL, CONVERSE, & RODGERS (1976)
MICHALOS (1991a, 1983)

CONCEPTUAL FRAMEWORK OF QUALITY OF LIFE
CAMPBELL, CONVERSE, & RODGERS (1976)


DEMOGRAPHICS
STANDARDS OF COMPARISON
DOMAIN 1
OBJECTIVE ATTRIBUTES
PERCEIVED ATTRIBUTES
EVALUATED ATTRIBUTES
SATISFACTION WITH DOMAIN
DOMAIN 2
OBJECTIVE ATTRIBUTES
PERCEIVED ATTRIBUTES
EVALUATED ATTRIBUTES
SATISFACTION WITH DOMAIN
DOMAIN 3
OBJECTIVE ATTRIBUTES
PERCEIVED ATTRIBUTES
EVALUATED ATTRIBUTES
SATISFACTION WITH DOMAIN
LIFE SATISFACTION

SATISFACTION WITH LIFE DOMAINS

CAMPBELL, CONVERSE, & RODGERS (1976)



COMPARISONS WITH:

BEST PREVIOUS EXPERIENCE

RELATIVES

AVERAGE PERSON

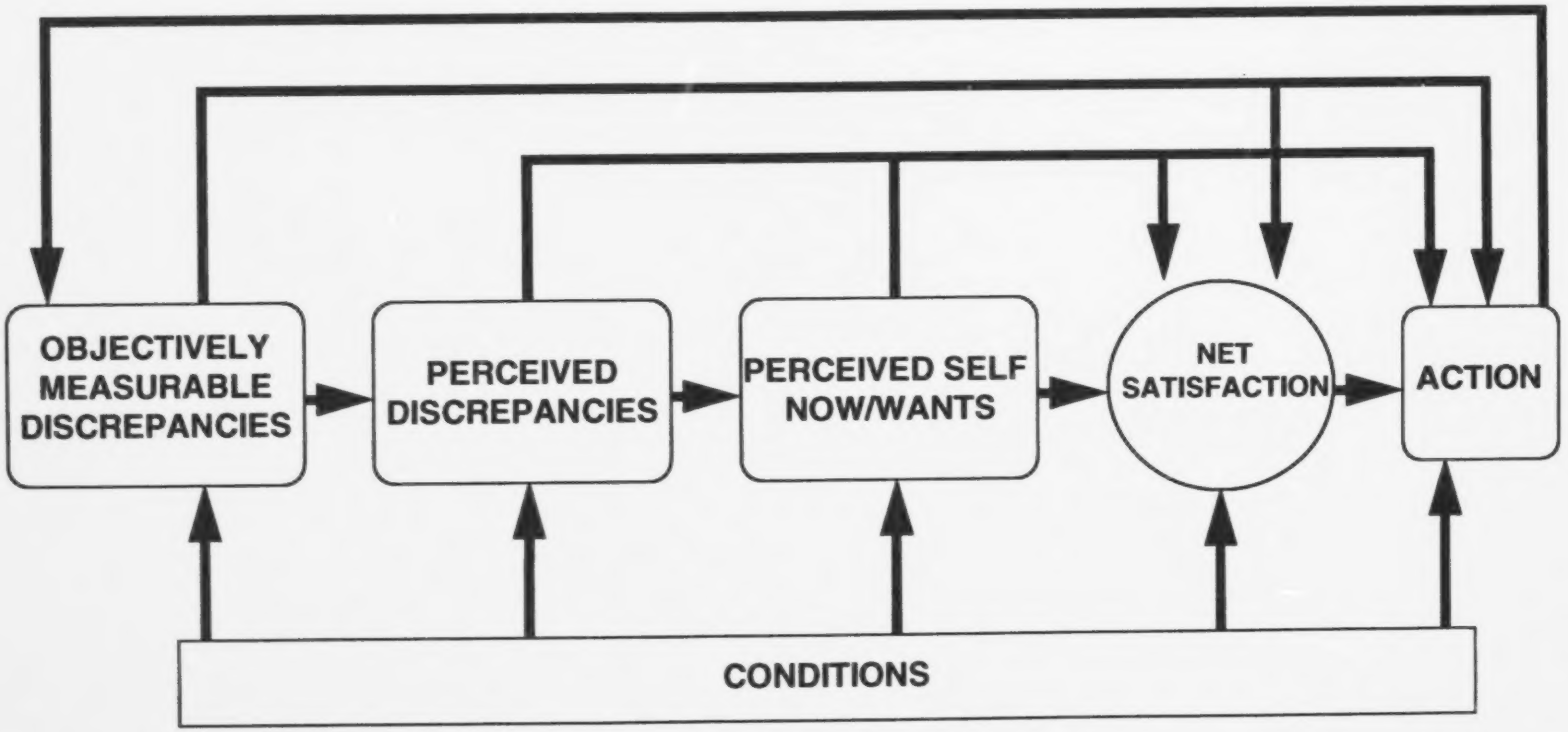
ALL OTHERS

ASPIRATION - ACHIEVEMENT GAP

DOMAIN SATISFACTION

MULTIPLE DISCREPANCIES THEORY

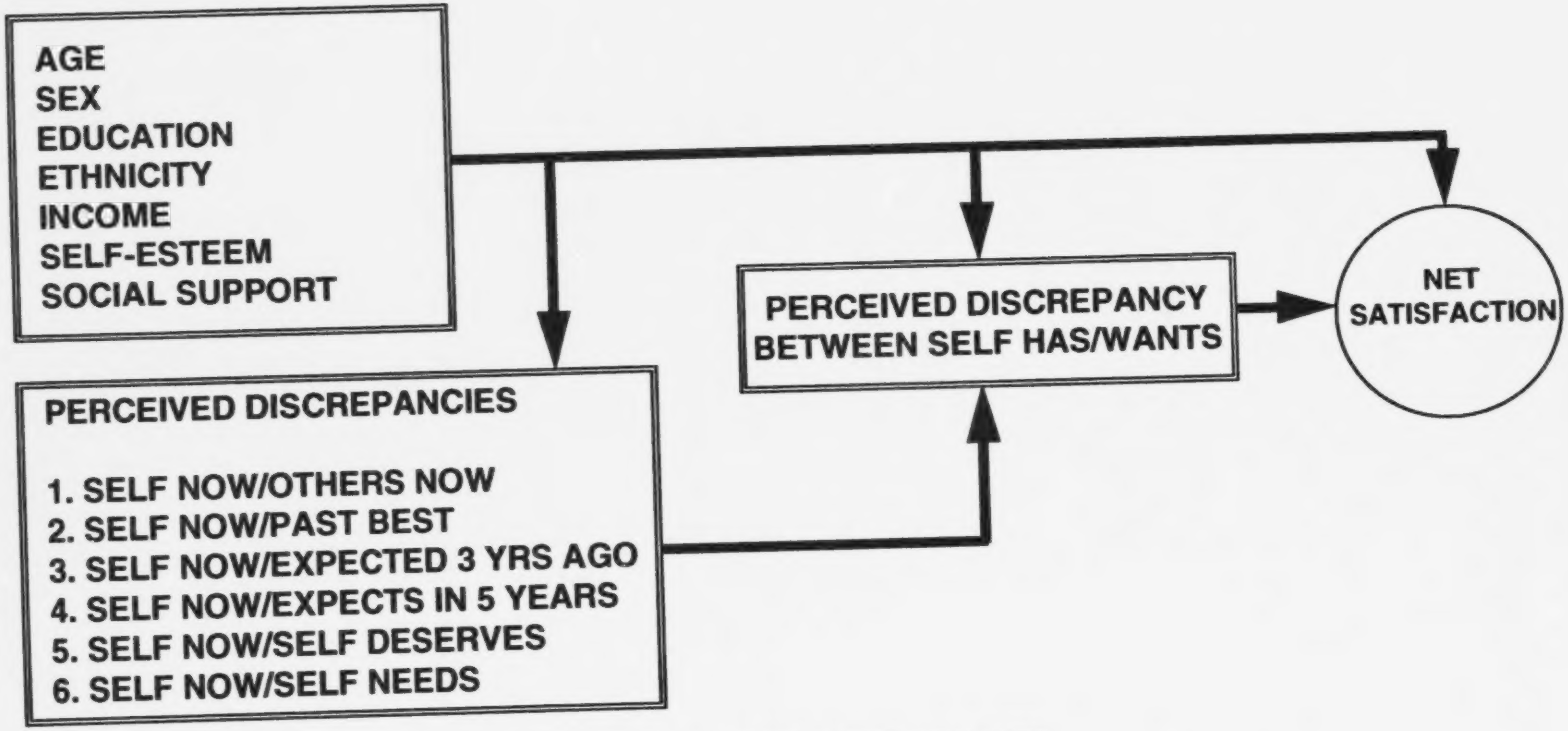
MICHALOS (1991a)


OBJECTIVELY MEASURABLE DISCREPANCIES
PERCEIVED DISCREPANCIES
PERCEIVED SELF NOW/WANTS
NET SATISFACTION
ACTION
CONDITIONS

SLIGHTLY MODIFIED

PERCEPTUAL CORE OF THE MULTIPLE DISCREPANCIES THEORY

MICHALOS (1991a)



AGE
SEX
EDUCATION
ETHNICITY
INCOME
SELF-ESTEEM
SOCIAL SUPPORT

PERCEIVED DISCREPANCIES

1. SELF NOW/OTHERS NOW
2. SELF NOW/PAST BEST
3. SELF NOW/EXPECTED 3 YRS AGO
4. SELF NOW/EXPECTS IN 5 YEARS
5. SELF NOW/SELF DESERVES
6. SELF NOW/SELF NEEDS

PERCEIVED DISCREPANCY BETWEEN SELF HAS/WANTS

NET SATISFACTION

FORMAT SLIGHTLY MODIFIED

APPENDIX B

REVIEW OF RESEARCH ON QUALITY OF LIFE AND CABG SURGICAL PATIENTS

RESEARCH DESIGNS AND CONCEPTUALIZATIONS

Appendix B

Quality of Life Of CABG Surgical Patients: Research Designs

STUDY NUMBER	ONE SHOT	ONE GROUP PRE-POST	STATIC GROUP COMPARISON	NON-EQUIVALENT CONTROL GROUP	TIME SERIES	RANDOMIZED	SAMPLING DETAILS	SAMPLE SIZE
1.		X					convenience	350 CABG
2.		X					convenience	79 CABG
3.						X	probability	780 CABG/MED
4.	X						convenience	29 CABG
5.		X					convenience	96 CABG
6.		X					convenience	76 preop 46 postop
7.		X					convenience	318 CABG
8.		X					convenience	100 CABG
9.	X						probability	95 CABG
10.		X					convenience	89 CABG
11.					X		convenience	34 CABG
12.					X		convenience	51 CABG
13.					X		convenience	30 CABG 14 t'plant
14.		X					convenience	225 preop 155 postop
15.						X	convenience	70 CABG 32 Valve 54 CABG/Valve
16.			X				convenience	44 CABG 32 PTCA
17.						X	convenience	201 CABG
18.		X					convenience	49 CABG

Quality of Life and CABG Surgical Patients

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Appendix B

Domains Examined Related to Quality of Life Of CABG Surgical Patients

Study	Survival	Health Profile	Sat. with Health	Symptom Distress	Psych Dx	Cognitive Function	Psychol Function	Self Image	Adjust Illness	Social Life	Leisure	Work Life	Fam Life	Sex Life	Sat with Life/SWB	Aspira- Achieve	Mood	Medical Complic	Function status	Economic status	Chang CABG
1.											x			x							x
2.			x	x	x	x	x		x	x	x	x	x	x		x	x				x
3.	x			x							x	x						x	x		x
4.			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	
5.			x				x		x	x		x	x	x							x
6.			x													x			x		x
7.	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8.	x		x	x	x		x		x	x		x	x	x	x			x	x		x
9.							x			x		x	x		x				x		x
10.				x			x	x	x	x	x	x	x	x				x			x
11.										x		x	x	x	x				x		x
12.			x						x	x		x		x	x	x		x	x		x
13.		x	x	x			x		x	x	x	x	x	x	x				x	x	x
14.		x	x	x						x	x	x			x	x	x	x	x		x
15.												x				x	x		x		x
16.				x			x						x		x		x	x	x		x
17.			x				x		x	x	x		x	x	x	x		x	x		x
18.			x						x					x	x	x	x		x	x	x

APPENDIX C

REVIEW OF RESEARCH ON QUALITY OF LIFE AND CABG SURGERY

INSTRUMENTS USED IN STUDYING QUALITY OF LIFE IN CABG SURGICAL PATIENTS

Appendix C

Instruments Used in Studying QOL in CABG Surgical Patients

Study	QOL Criteria	Assessment Tools	Subjective	Objective	Reference
1.	Avocational Activity	Milwaukee Cardiovascular Quality of Life Inventory	X		[1]
2.	Psychiatric Diagnosis	Present State Examination		X	[2]
	Mood	Lorr McNair Self-report Mood questionnaire	X		[3]
	Cognitive Function	Wechsler Adult Intelligence Scale		X	[4]
	Social Activities				*
	Satisfaction with work, leisure, family & sexual relations	Social Difficulty Questionnaire	X		*
	Expectations of surgery		X		*
	Everyday activity	Interviewer Rating		X	*
3.	Chest Pain Status	CCS Classification	X		[5]
	Heart Failure			X	*
	Activity Limitation			X	*
	Employment Status			X	*
	Recreational Status			X	*
	Drug Therapy			X	*
	Hospitalization			X	*
	Risk factors: smoking, Hypertension, wt, Chol			X	*
	Exercise Stress Test	Modified Maximum Bruce Protocol		X	~
	Coronary blood flow	Coronary Angiography		X	~
4.	Global Life Satisfaction	Cantril's SASS	X		[6]
	Satisfaction with: relief of symptoms, physical activity, leisure, social activities, family, sexual activities, wealth, ability to work & mood (also Importance of each)	Cantril's SASS	X		[6]
	Demographic & Occupation	Sociological-health Status Inventory		X	*
	Social Support	Social Support Scale	X		[7]
	Physical Functioning	Exercise Stress Test		X	*
		Rehospitalizations		X	*
		Complications		X	*
		Chronic Illness		X	*
5.	Psychosocial Adjustment To Illness: sexual functioning, vocational status, domestic environ., extended family relations, social activities, psychologic distress & Health concerns	Psychosocial Adjustment To Illness Scale	X		[8]

Study	QOL Criteria	Assessment Tools	Subjective	Objective	Reference
6.	Impact of Illness on family, work status, expectations of surgery, realized benefits, prediction of repeat CABG	Unstructured Interview	X		*
	Medical data: symptoms, exercise level, risk factors, medical history	Chart Review		X	*
		Telephone Interview	X		*
7.	Dyspnea	London School of Hygiene Dyspnea Questionnaire		X	~
	Angina	Modified London School of Hygiene Cardiovascular Questionnaire	X		[9]
	Psychoneurological Functioning	Trailmaking Test		X	[10]
		Wechsler Memory Scale (visual reproduction & logical memory)		X	[11]
	Mood	Profile of Mood States	X		[3]
	Anxiety	State-Trait Anxiety Inventory	X		[12]
	Affect	Affective Balance Scale	X		[13]
	Self-Esteem	Self-Esteem Scale	X		[14]
	Hopelessness	The Hopelessness Scale	X		[15]
	Dependency	Interview	X		~
	Locus of Control	Interview	X		~
	Willingness to Accept Help	Interview	X		~
	Medical history & Complications	Chart Review & Cardiac Catheterization		X	*
	Medications	Chart Review		X	*
	Physical Activity	Factor Analytically Derived Scales	X		~
8.	Psychiatric Diagnosis	Psychiatric Evaluation Form		X	[16]
	Personality	Cattell 16 Personality Factor Questionnaire	X		[17]
	Type A Behavior	Rosenman-Friedman Standard Interview (type A, aggressive content, vocal style, job commitment, sense of time urgency)	X		~
	Demographics, medical data, psychosocial & behavioral data, compliance with reducing risk factors	Questionnaire	X		*
	Fatalities, medical Complications, physical Limits			X	*
		Interview patient or Physician or both		X	*

Study	QOL Criteria	Assessment Tools	Subjective	Objective	Reference
9.	Demographics Occupation, work Status, desire to work, social support,	Structured Interview Questionnaire	X		*
	Physical Limitations	Index of Perceived Physical Limits	X		[18]
10.	Psychosocial Adjustment to Illness	Psychosocial Adjustment to Illness Scale	X		[8]
	Medical History	Chart Review		X	*
	Social & Family Life	The Pleasant Events Schedule	X		[19]
	Depression	The Centre for Epidemiological Studies Depression Scale	X		[20]
	Anxiety	State-Trait Anxiety Inventory	X		[12]
	Medical data: rehospitalizations, medical visits, cardiac symptoms, cardiac medications, complications	Chart Review		X	*
	Satisfaction with Surgical Outcome	Seven-point bipolar scale	X		~
11.	Angina	Graded Scale	X		[21]
	Medical History,	Medical Record		X	*
	Activity level	City blocks walked	X		*
	Employment	Hours worked/week	X		*
	Present, past & future Life Satisfaction	Cantril's SASS	X		[6]
	Satisfaction with family, social, sexual, & occupational life	Likert Scale	X		[22]
12.	Dispositional Optimism	Life Orientation Test	X		[23]
	Expectations of Surgery for: pain, fatigue, nervousness, sadness, anger & relief, Happiness, satisfaction with medical care	4-point Likert Scale	X		*
	Expectation of time to: return to work, social activities, recreation, sexual activities & physical exercise	Counted Number of weeks	X		*

Study	QOL Criteria	Assessment Tools	Subjective	Objective	Reference
12.	Medical history & Surgical data: complications	Chart Review		X	*
	Recovery, morale & Prognosis	Staff Rated on 3-point Likert Scale		X	*
	Physical ability: i.e. walking in room	Physical milestones (time to achieve)		X	*
	Medical Complications	Rose Questionnaire		X	[24]
	Quality of Life	Perceived Quality of Life Scale	X		[25]
	Coping Strategies: denial, thought suppression, seeking information	Questionnaire	X		*
	Mood: depression, anxiety & hostility	Multiple Affect Adjective Check List	X		[26]
13.	Social functioning: pain, energy, physical mobility, sleep, social isolation, emotional reactions	Nottingham Health Profile (Part 1)	X		[27]
	Daily life affected by Illness: occupation, domestic activities, social life, family, sex life, hobbies, interests & holidays	Nottingham Health Profile (Part 2)	X		[27]
	Quality of Life: professional, financial, symptoms, life-style, expectations	Quality of Life Questionnaire	X		*
14.	Global Life Satisfaction	Satisfaction With Life Scale	X		[28]
	Affective Mood State	Profile of Mood States	X		[29]
	Functional Disruption	Sickness Impact Profile Subscales: sleep & rest, home management, ambulation, social interaction, intellectual function & recreation and pastimes.	X		[30]
	Risk Factors	Chart review & Patient Report	X	X	
	Angina Severity Index	Questionnaire (7-point Scale)	X		*
	Perceptions Of The Consequences of Surgery	Interview - open-ended questions	X		*
	Return To Work	Patient Report	X		*
	Rehospitalization	Patient Report & Chart Review	X	X	*

Study	QOL Criteria	Assessment Tools	Subjective	Objective	Reference
15.	Cardiac History	Chart Review		X	*
	Heart Function	NYHA Class (Chart Review)		X	*
	Affective Mood	Profile of Mood States	X		[29]
	Self-Efficacy	Self-Efficacy Scales (walking, lifting, climbing, general activity, & Work)	X		[31]
	Activity (last 24 Hours)	Activity Check List	X		*
	Quality of Life	0-10 Scale			*
16.	Medical History	Chart review		X	*
	Quality of Life	Quality of Life Index, Cardiac Version III	X		[32]
	Affective Mood	Profile of Mood States	X		[33]
	Physical Functioning	Physical Functioning Questionnaire		X	[34]
17.	Operative Complications	Chart Review		X	*
	Rehospitalizations	Patient Report	X		*
	Angina	Patient Report	X		*
	Medications	Patient Report	X		*
	Depression	Beck Depression Inventory	X		[15]
	Expectations of Surgery	Questionnaire	X		*
	Factors Contributing to Recovery	Questionnaire	X		*
	Perceptions of Surgery, health, & overall life situation	Questionnaire	X		*
	Satisfaction with sexual life	Questionnaire	X		*
	Daily Activities	Questionnaire	X		*
18.	Disease Severity	Ejection Fraction		X	
	Quality of Life:				
	Angina Pain,	NYHA Class	X		
	Negative Affect	Positive & Negative Affective Schedule	X		[35]
	Life Satisfaction (General satisfaction, Satisfaction with activity level, Satisfaction with sexual functioning)	3-item 5-point scale (composite score)	X		[36]
	Locus of Control	The Internal Health Locus of Control subscale of the Multidimensional Health Locus of Control Scale (HLOC, Form A)	X		[37]
	Specific Control Appraisal	10-point scale	X		[38]
	Generalized Outcome Expectancies:				
	Dispositional Optimism	Life Orientation Test	X		[23]
	Specific Expectancies of CABG Surgery (activity level, sexual functioning, overall capacity)	3 item, 5-point scales	X		*

* Unstandardized instrument developed for study

~ Method of evaluation not described

APPENDIX C

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APPENDIX D

INDEX OF WELL-BEING
CAMPBELL, CONVERSE, & RODGERS (1976)

INDEX OF WELL-BEING

CAMPBELL, CONVERSE, AND RODGERS (1976)

BORING	___	___	___	___	___	___	___	INTERESTING
ENJOYABLE	___	___	___	___	___	___	___	MISERABLE
EASY	___	___	___	___	___	___	___	HARD
USELESS	___	___	___	___	___	___	___	WORTHWHILE
FRIENDLY	___	___	___	___	___	___	___	LONELY
FULL	___	___	___	___	___	___	___	EMPTY
DISCOURAGING	___	___	___	___	___	___	___	HOPEFUL
TIED DOWN	___	___	___	___	___	___	___	FREE
DISAPPOINTING	___	___	___	___	___	___	___	REWARDING
BRINGS OUT THE BEST IN ME	___	___	___	___	___	___	___	DOESN'T GIVE ME MUCH CHANCE

HOW SATISFIED ARE YOU WITH YOUR LIFE AS A WHOLE?

NOT AT ALL SATISFIED	___	___	___	___	___	___	___	**VERY SATISFIED**

APPENDIX E

LIFE 3 SCALE
ANDREWS AND WITHEY (1976)

LIFE 3 SCALE

ANDREWS AND WITHEY (1976)

1	2	3	4	5	6	7
TERRIBLE	UNHAPPY	MOSTLY DISSATISFIED	MIXED (ABOUT EQUALLY SATISFIED & DISSATISFIED)	MOSTLY SATISFIED	PLEASED	DELIGHTED

1. HOW DO YOU FEEL ABOUT YOUR LIFE AS A WHOLE? _____(NUMBER)

2. HOW DO YOU FEEL ABOUT YOUR LIFE AS A WHOLE? _____(NUMBER)

(PRESENT AGAIN AT THE END OF INTERVIEW)

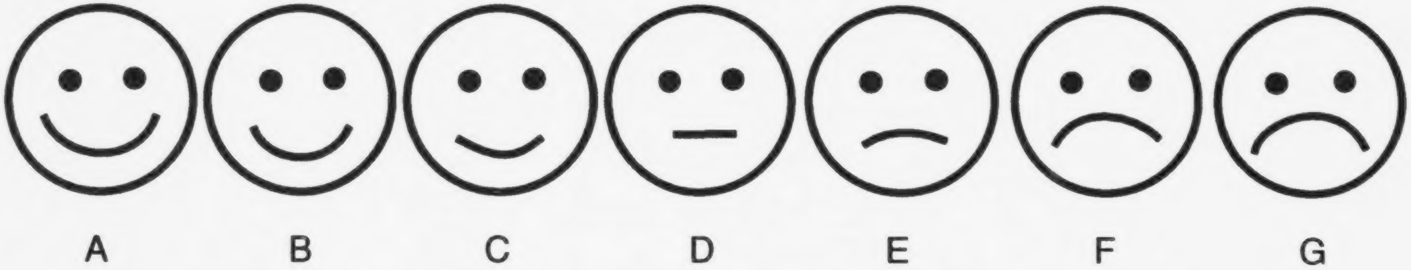
APPENDIX F

FACES SCALE
ANDREWS AND WITHEY (1976)

Faces Scale

Andrews & Withey (1976)

"Here are some faces expressing various feelings. Below each is a letter. Which face comes closest to expressing how you feel about [your life as a whole]?"

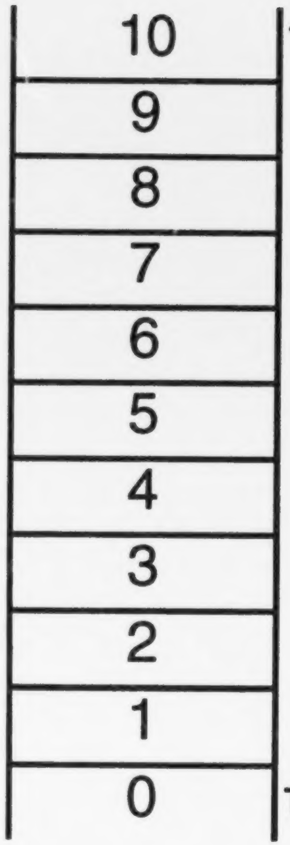


APPENDIX G

SELF-ANCHORING STRIVING SCALE
CANTRIL (1965)

SELF-ANCHORING STRIVING SCALE

CANTRIL (1965)



THE BEST YOU CAN IMAGINE

WHERE ON THE LADDER WOULD YOU PLACE:

1. YOUR PRESENT LIFE ______
2. YOUR LIFE WHEN IT WAS THE BEST IT HAS EVER BEEN ______
3. THE LIFE YOU HAD LAST YEAR ______
4. THE LIFE YOU EXPECT TO HAVE IN ONE YEAR ______

THE WORST YOU CAN IMAGINE

APPENDIX H

SATISFACTION WITH LIFE DOMAINS

CAMPBELL, CONVERSE, & RODGERS (1976)

Satisfaction With Family Life

All things considered, how satisfied are you with your family life - the time you spend and the things you do with members of your family? Which number comes closest to how you feel? (p. 553)

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Satisfaction with Health

Of course, most people get sick now and then, but overall, how satisfied are you with your own health? Which number comes closest to how you feel? (p. 545)

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Satisfaction with Friends

All things considered, how satisfied are you with your friendships - with the time you spend with friends, the things you do together, the number of friends you have, as well as the particular people who are your friends? Which number comes closest to how you feel? (p. 547)

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

Satisfaction with Self

How do you feel about how you have been able to satisfy your ambitions in life up to now? (Adapted from p. 556)

Completely Dissatisfied	1	2	3	4	5	6	7	Completely Satisfied

ANDREWS & WITHEY (1976)

Satisfaction with Family

How do you feel about the things you and your family do together?

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied & dissatisfied)	Mostly satisfied	Pleased	Delighted

Satisfaction with Health

How do you feel about your own health and physical condition?

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied & dissatisfied)	Mostly satisfied	Pleased	Delighted

Satisfaction with Friends

How do you feel about your friends?

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied & dissatisfied)	Mostly satisfied	Pleased	Delighted

Satisfaction with Self

How do you feel about what you have accomplished in your life?

1	2	3	4	5	6	7
Terrible	Unhappy	Mostly Dissatisfied	Mixed (about equally satisfied & dissatisfied)	Mostly satisfied	Pleased	Delighted

APPENDIX I

MULTIPLE DISCREPANCIES THEORY QUESTIONNAIRE

Source: Michalos, A. (1984). Satisfaction and Happiness Survey (1984-1985). University Students. Social Indicators Research, University of Guelph.

I am interested in **your own feelings** and the **quality** of your life at the present time. Or, to put it another way, I am interested in the things that are satisfying or dissatisfying to you in your day-to-day living.

RATING YOUR OWN LIFE

In this section of the questionnaire I would like you to **consider your life as it is right now**.

To assist you in giving your rating I have designed a LABELED SCALE which runs from "TERRIBLE" to "DELIGHTFUL" in seven equal steps. Each of these steps has a corresponding number.

When you have picked the label from the scale that **comes closest** to describing how you **feel** about your life, please put a check mark on the scale under the label and number you have picked.

---

1. HOW DO YOU FEEL ABOUT **YOUR LIFE AS A WHOLE** RIGHT NOW? IS **LIFE GENERALLY** DISSATISFYING, SATISFYING, ETC.?

1	2	3	4	5	6	7
Terrible	Very Dissatisfying	Dissatisfying	Mixed	Satisfying	Very Satisfying	Delightful

---

RATING YOUR LIFE COMPARED TO WHAT YOU WANT

For this question I want you to consider how you would rate your own life right now in terms of your **life approaching what you want**.

---

2. CONSIDER YOUR **LIFE AS A WHOLE**. HOW DOES IT MEASURE UP TO YOUR GENERAL ASPIRATIONS OR WHAT YOU WANT? **GENERALLY, DOES LIFE PROVIDE WHAT YOU WANT** FAIRLY POORLY, WELL, ETC.?

1	2	3	4	5	6	7
Not at all	Fairly Poorly		Half as well as what you want	Fairly Well		Matches or is better than what you want

RATING YOUR LIFE COMPARED TO AVERAGE PEOPLE YOUR AGE AND SEX

In this question I would like you to think about your **present day-to-day life in comparison with the life of other people your own age and sex.**

---

3. CONSIDER YOUR LIFE AS A WHOLE. **HOW DOES IT MEASURE UP TO THE AVERAGE** FOR MOST PEOPLE YOUR OWN AGE AND SEX IN THIS AREA? **GENERALLY**, IS WHAT YOUR LIFE OFFERS YOU BELOW AVERAGE, ABOVE, ETC.?

1 2 3 4 5 6 7

Far below Average	Below Average	Average	Above Average	Far above Average

---

RATING YOUR LIFE COMPARED TO WHAT YOU DESERVE

For this question I want you to consider how you would rate your own life, as it is at present in comparison to **what it would be if you got exactly what you think you deserve** (for whatever reason).

---

4. CONSIDER **YOUR LIFE AS A WHOLE.** HOW DOES IT MEASURE UP TO THE LIFE YOU THINK YOU DESERVE? IS IT BELOW **WHAT YOU DESERVE**, ABOVE, ETC.?

1 2 3 4 5 6 7

Far below what is deserved	Below what is deserved	Matches exactly what is deserved	Above what is deserved	Far above what is deserved

---

RATING YOUR LIFE COMPARED TO WHAT YOU NEED

I want you to consider how you would rate your own life, as it is at present in comparison to **what it would be if you got exactly what you need.**

---

5. CONSIDER **YOUR LIFE AS A WHOLE.** HOW DOES IT MEASURE UP TO WHAT YOU THINK YOU NEED? IS WHAT YOUR LIFE OFFERS NOW **GENERALLY** BELOW **WHAT YOU NEED**, ABOVE, ETC.?

1	2	3	4	5	6	7
Far below what is needed		Below what is needed	Matches exactly what is needed	Above what is needed		Far above what is needed

---

RATING YOUR LIFE COMPARED TO PAST THREE YEAR EXPECTATIONS

I want you to consider how you would rate your own life, as it is at present, in comparison to **what you expected it would be** three years ago.

---

6. CONSIDER **YOUR LIFE AS A WHOLE.** HOW DOES IT MEASURE UP TO WHAT YOU EXPECTED THREE YEARS AGO? **DOES IT OFFER LESS NOW THAN YOU EXPECTED IT WOULD**, MORE, ETC.?

1	2	3	4	5	6	7
Extremely less	Much Less	Less	About as expected	More	Much more	Extremely more

---

RATING YOUR LIFE COMPARED TO FUTURE FIVE YEAR EXPECTATIONS

I want you to consider how you would rate your own life as it is at present, in comparison to what you expect it will be five years from now.

---

7. **CONSIDER YOUR LIFE AS A WHOLE. DOES IT OFFER MUCH LESS NOW THAN YOU EXPECT LATER**, MUCH MORE, ETC.?

1	2	3	4	5	6	7
Extremely less	Much less	Less	About the same	More	Much more	Extremely more

---

RATING YOUR LIFE COMPARED TO YOUR PREVIOUS BEST

For this question I want you to consider how you would rate your own life, at the present, in comparison to the previous best experience of your life.

---

8. CONSIDER **YOUR LIFE AS A WHOLE.** HOW DOES IT MEASURE UP TO THE BEST IN YOUR PREVIOUS EXPERIENCE? **IS IT GENERALLY BELOW THE PREVIOUS BEST**, ABOVE IT, ETC.?

1	2	3	4	5	6	7
Far below the Previous best	Below the Previous best		Matches the Previous best	Above the Previous best		Far above the Previous best

APPENDIX J

THE MOS 36-ITEM SHORT-FORM HEALTH SURVEY (SF-36)

THE MOS 36-ITEM SHORT-FORM HEALTH SURVEY (SF-36)
(ACUTE)

INSTRUCTIONS: This survey asks for your views about your health now and during the past week. This information will help keep track of how you feel and how well you are able to do your usual activities.

Answer every question by marking the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is: (circle one)

Excellent	1
Very good	2
Good	3
Fair	4
Poor	5

2. Compared to one week ago, how would you rate your health in general now?

(circle one)

Much better now than one week ago	1
Somewhat better now than one week ago	2
About the same as one week ago	3
Somewhat worse now than one week ago	4
Much worse now than one week ago	5

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3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

(circle one number on each line)

ACTIVITIES	**Yes, Limited A Lot**	**Yes, Limited A Little**	**No, Not Limited At All**
a. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b. **Moderate activities**, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	1	2	3
c. Lifting or carrying groceries	1	2	3
d. Climbing **several** flights of stairs	1	2	3
e. Climbing **one** flight of stairs	1	2	3
f. Bending, kneeling, or stooping	1	2	3
g. Walking **more than one mile**	1	2	3
h. Walking **several blocks**	1	2	3
i. Walking **one block**	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the past week, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

(circle one number on each line)

	YES	**NO**
a. Cut down on the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Were limited in the **kind** of work or other activities	1	2
d. Had **difficulty** performing the work or other activities (for example, it took extra effort)	1	2

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5. During the past week, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

(circle one number on each line)

	YES	NO
a. Cut down on the **amount of time** you spent on work or other activities	1	2
b. **Accomplished less** than you would like	1	2
c. Didn't do work or other activities as **carefully** as usual	1	2

6. During the past week, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

(circle one)

Not at all	1
Slightly	2
Moderately	3
Quite a bit	4
Extremely	5

7. How much bodily pain have you had during the past week? (circle one)

None	1
Very mild	2
Mild	3
Moderate	4
Severe	5
Very severe	6

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8. During the past week, how much did pain interfere with your normal work (including both work outside the home and housework)?

(circle one)

Not at all	1
A little bit	2
Moderately	3
Quite a bit	4
Extremely	5

9. These questions are about how you feel and how things have been with you during the past week. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past week -

(circle one number on each line)

	All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
a. Did you feel full of pep?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and blue?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

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10. During the past week, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

(circle one)

All of the time 1

Most of the time 2

Some of the time 3

A little of the time 4

None of the time 5

11. How TRUE or FALSE is each of the following statements for you?

(circle one number on each line)

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
a. I seem to get sick a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

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APPENDIX K

BIOGRAPHICAL DATA AND MEDICAL HISTORY

Study No.__________

Last Name:________________________ First Name:____________________

Address: ________________________________

____

Phone: (Home):___________________ Work: ____________________

Surgeon:___________________________ Cardiologist:_________________

Date of Birth: ___________________ Marital Status:______________

Education Level:________________________ Race:____________________

Occupation: _______________________ Employment Status:__________

Months not working preop__________ Employment status:_________
(3 month follow-up)

Medical History

CCS Class: ___/___/___ ______ Hypertension:___/___/___
dd mm yy Class

NYHA Class:___/___/___ ______

Angina Type: Stable____ Unstable____

Diabetes: ___/___/___ _______ Ejection Fraction:_____
Type

Date of EF: ___/___/___

CAD First Diagnosed: Cardiac Catheterization: ___/___/___

Previous MI: ___/___/___ Location:__________________

___/___/___ Location:__________________

___/___/___ Location:__________________

Previous PTCA:___/___/___ Location:__________________

___/___/___ Location:__________________

___/___/___ Location:__________________

Obesity: ___/___/___

Smoking: Start date:___/___/___

End date: ___/___/___

Smoking Now:___yes ___no Hypercholesterolemia: ___/___/___

Date on wait List: ___/___/___ Number of Times Surgery Canceled: ____

Surgical Data

Surgery: Surgery Start: ___/___/___ Surgery End: ___/___/___

Pump Time: On Pump: ___/___/___ Off Pump: ___/___/___

Vessels Grafted:____

____

____

____

Number of Bypass Grafts: ___________

Length of Hospital Stay: Admit Date: ___/___/___

ICU Admit Date:___/___/___

Discharge Date:___/___/___

Total Length of Stay: _______ days

Surgical Complications:

IABP: Date In: ___/___/___ Date Out: ___/___/___

VAD: DAte In: ___/___/___ Date Out: ___/___/___

Hemorrhage: ___/___/___

Decompression of tamponade: ___/___/___

Sternal Debridement: ___/___/___

Perioperative MI: ___/___/___

Stroke: ___/___/___

Other:_________________________________

DIVISION OF CARDIOTHORACIC SURGERY
QUALITY OF LIFE AFTER CABG SURGERY
CLINICAL OUTCOMES AT FIRST FOLLOW-UP

LAST NAME:______________________ FIRST NAME:____________________

SURGERY DATE:___________________ FOLLOW-UP DATE:________________

CCS CLASS: ________
NYHA CLASS:________

AGE STARTED SMOKING:_______ YEARS
QUIT SMOKING ON ___/___/___
SMOKED: _______ PK/DAY

HAS PATIENT BEEN HOSPITALIZED SINCE SURGERY: ___NO ___YES
READMISSION DATE:___/___/___
REASON:_____________________

RISK FACTOR MANAGEMENT:
HYPERTENSION: _______
DIABETES: _______
HIGH CHOLESTEROL: _______
SMOKING _______
FAMILIAL DISEASE _______

MEDICAL HISTORY SINCE SURGERY

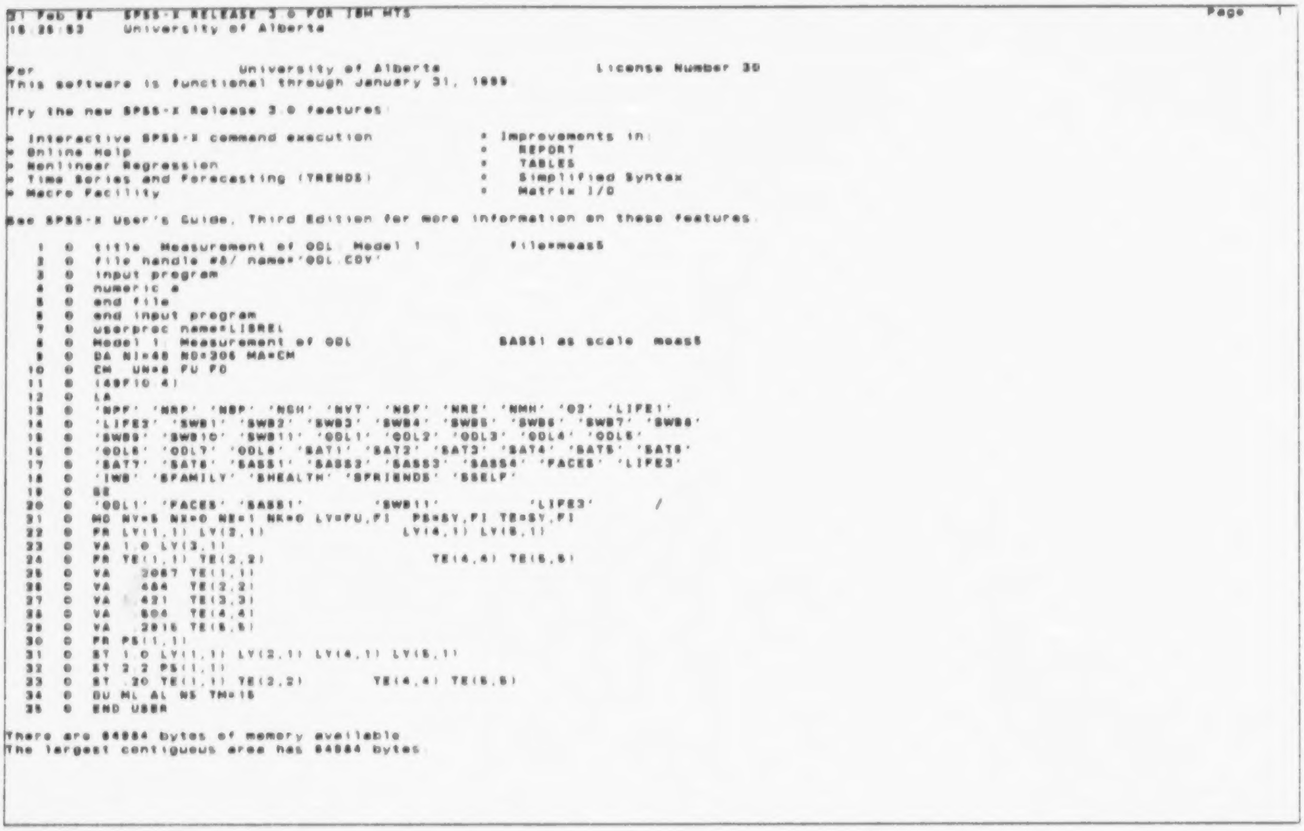
NORMAL	ABNORMAL	SPECIFY
CARDIOVASCULAR		ARRHYTHMIAS: STRESS TEST:
PULMONARY		
GASTROINTESTINAL		
METABOLIC		
RENAL		
GENITOUROLOGIC		
MUSCULOSKELETAL		
NEUROLOGIC		
PSYCHOLOGICAL		
DERMATOLOGICAL		

IS THE PATIENT BACK TO WORK?____NO ___YES WHEN? ___/_____/___
___FULL-TIME
___PART-TIME

____
SURGEON

APPENDIX L

LISREL OUTPUT FOR MEASUREMENT OF QUALITY OF LIFE: MODEL 1



```
21 Feb 94   SPSS-X RELEASE 3.0 FOR IBM MTS                                                                     Page    1
15:25:53    University of Alberta

For                     University of Alberta                  License Number 30
This software is functional through January 31, 1995.

Try the new SPSS-X Release 3.0 features:

* Interactive SPSS-X command execution               * Improvements in:
* Online Help                                        *    REPORT
* Nonlinear Regression                               *    TABLES
* Time Series and Forecasting (TRENDS)               *    Simplified Syntax
* Macro Facility                                     *    Matrix I/O

See SPSS-X User's Guide, Third Edition for more information on these features.

   1  0  title  Measurement of QOL  Model 1          file=meas5
   2  0  file handle #8/ name='QOL.COV'
   3  0  input program
   4  0  numeric a
   5  0  end file
   6  0  end input program
   7  0  userproc name=LISREL
   8  0  Model 1. Measurement of QOL                  SASS1 as scale  meas5
   9  0  DA NI=48 NO=306 MA=CM
  10  0  CM  UN=8 FU FO
  11  0  (48F10.4)
  12  0  LA
  13  0  'NPF' 'NRP' 'NBP' 'NCH' 'NVT' 'NSF' 'NRE' 'NMH' 'O2' 'LIFE1'
  14  0  'LIFE2' 'SWB1' 'SWB2' 'SWB3' 'SWB4' 'SWB5' 'SWB6' 'SWB7' 'SWB8'
  15  0  'SWB9' 'SWB10' 'SWB11' 'QOL1' 'QOL2' 'QOL3' 'QOL4' 'QOL5'
  16  0  'QOL6' 'QOL7' 'QOL8' 'SAT1' 'SAT2' 'SAT3' 'SAT4' 'SAT5' 'SAT6'
  17  0  'SAT7' 'SAT8' 'SASS1' 'SASS2' 'SASS3' 'SASS4' 'FACES' 'LIFE3'
  18  0  'IWB' 'SFAMILY' 'SHEALTH' 'SFRIENDS' 'SSELF'
  19  0  SE
  20  0  'QOL1' 'FACES' 'SASS1'        'SWB11'          'LIFE3'       /
  21  0  MO NY=5 NX=0 NE=1 NK=0 LY=FU,FI  PS=SY,FI TE=SY,FI
  22  0  FR LY(1,1) LY(2,1)                    LY(4,1) LY(5,1)
  23  0  VA 1.0 LY(3,1)
  24  0  FR TE(1,1) TE(2,2)                    TE(4,4) TE(5,5)
  25  0  VA   .2087 TE(1,1)
  26  0  VA   .484  TE(2,2)
  27  0  VA  1.421  TE(3,3)
  28  0  VA   .504  TE(4,4)
  29  0  VA   .2815 TE(5,5)
  30  0  FR PS(1,1)
  31  0  ST 1.0 LY(1,1) LY(2,1) LY(4,1) LY(5,1)
  32  0  ST 2.2 PS(1,1)
  33  0  ST  .20 TE(1,1) TE(2,2)        TE(4,4) TE(5,5)
  34  0  OU ML AL NS TM=15
  35  0  END USER

There are 84884 bytes of memory available.
The largest contiguous area has 84884 bytes.
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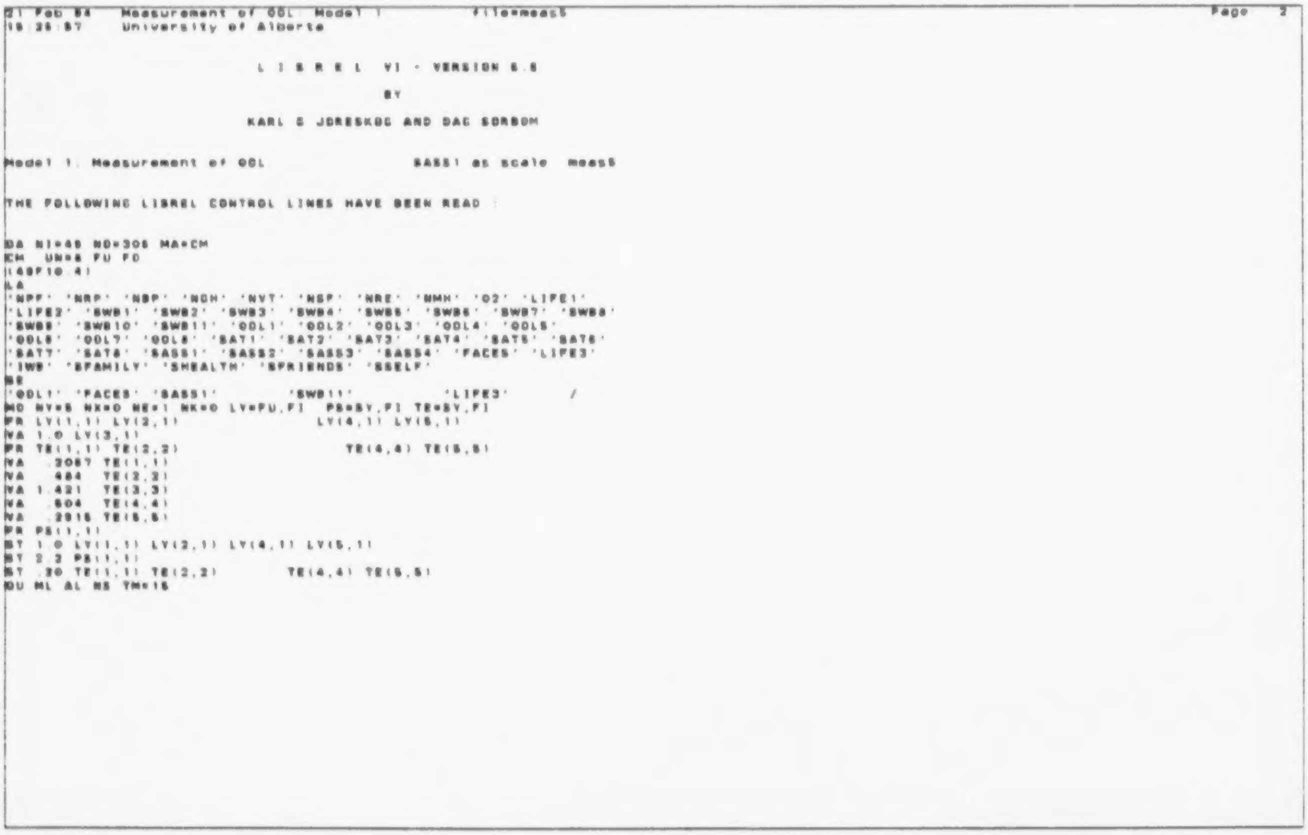


```
21 Feb 94   Measurement of QOL  Model 1          file=meas5                                                     Page    2
15:25:57    University of Alberta

                        L I S R E L  VI - VERSION 6.6

                                     BY

                        KARL G JORESKOG AND DAG SORBOM

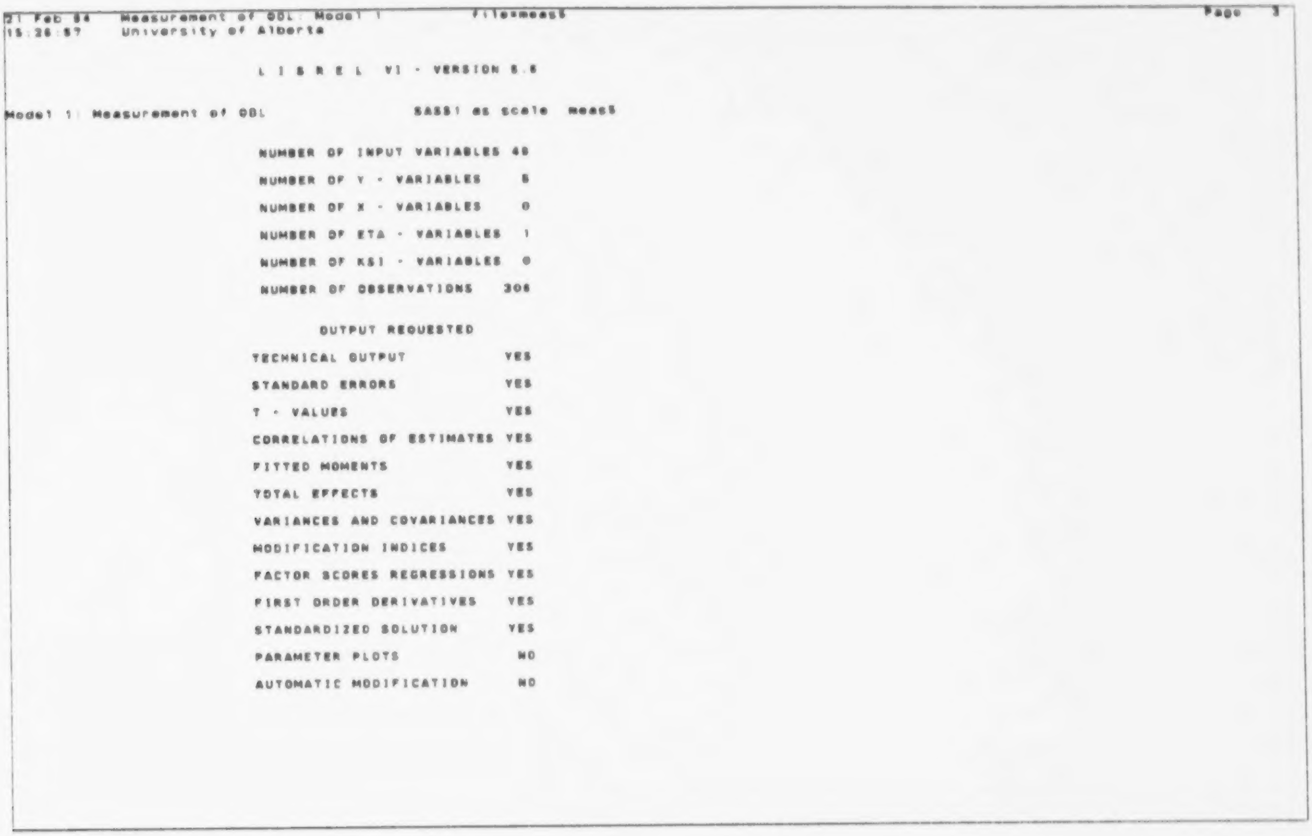
Model 1. Measurement of QOL                  SASS1 as scale  meas5


THE FOLLOWING LISREL CONTROL LINES HAVE BEEN READ :


DA NI=48 NO=306 MA=CM
CM  UN=8 FU FO
(48F10.4)
LA
'NPF' 'NRP' 'NBP' 'NCH' 'NVT' 'NSF' 'NRE' 'NMH' 'O2' 'LIFE1'
'LIFE2' 'SWB1' 'SWB2' 'SWB3' 'SWB4' 'SWB5' 'SWB6' 'SWB7' 'SWB8'
'SWB9' 'SWB10' 'SWB11' 'QOL1' 'QOL2' 'QOL3' 'QOL4' 'QOL5'
'QOL6' 'QOL7' 'QOL8' 'SAT1' 'SAT2' 'SAT3' 'SAT4' 'SAT5' 'SAT6'
'SAT7' 'SAT8' 'SASS1' 'SASS2' 'SASS3' 'SASS4' 'FACES' 'LIFE3'
'IWB' 'SFAMILY' 'SHEALTH' 'SFRIENDS' 'SSELF'
SE
'QOL1' 'FACES' 'SASS1'        'SWB11'          'LIFE3'       /
MO NY=5 NX=0 NE=1 NK=0 LY=FU,FI  PS=SY,FI TE=SY,FI
FR LY(1,1) LY(2,1)                    LY(4,1) LY(5,1)
VA 1.0 LY(3,1)
FR TE(1,1) TE(2,2)                    TE(4,4) TE(5,5)
VA   .2087 TE(1,1)
VA   .484  TE(2,2)
VA  1.421  TE(3,3)
VA   .504  TE(4,4)
VA   .2815 TE(5,5)
FR PS(1,1)
ST 1.0 LY(1,1) LY(2,1) LY(4,1) LY(5,1)
ST 2.2 PS(1,1)
ST  .20 TE(1,1) TE(2,2)        TE(4,4) TE(5,5)
OU ML AL NS TM=15
```

University of Alberta

University of Alberta



```
21 Feb 84    Measurement of ODL: Model 1            File=meas5                              Page   3
15:26:57     University of Alberta

                         L I S R E L  VI - VERSION 5.5

Model 1: Measurement of ODL                    SASS1 as scale  meas5

                           NUMBER OF INPUT VARIABLES 48

                           NUMBER OF Y - VARIABLES    5

                           NUMBER OF X - VARIABLES    0

                           NUMBER OF ETA - VARIABLES  1

                           NUMBER OF KSI - VARIABLES  0

                           NUMBER OF OBSERVATIONS   306

                                OUTPUT REQUESTED

                          TECHNICAL OUTPUT           YES

                          STANDARD ERRORS            YES

                          T - VALUES                 YES

                          CORRELATIONS OF ESTIMATES  YES

                          FITTED MOMENTS             YES

                          TOTAL EFFECTS              YES

                          VARIANCES AND COVARIANCES  YES

                          MODIFICATION INDICES       YES

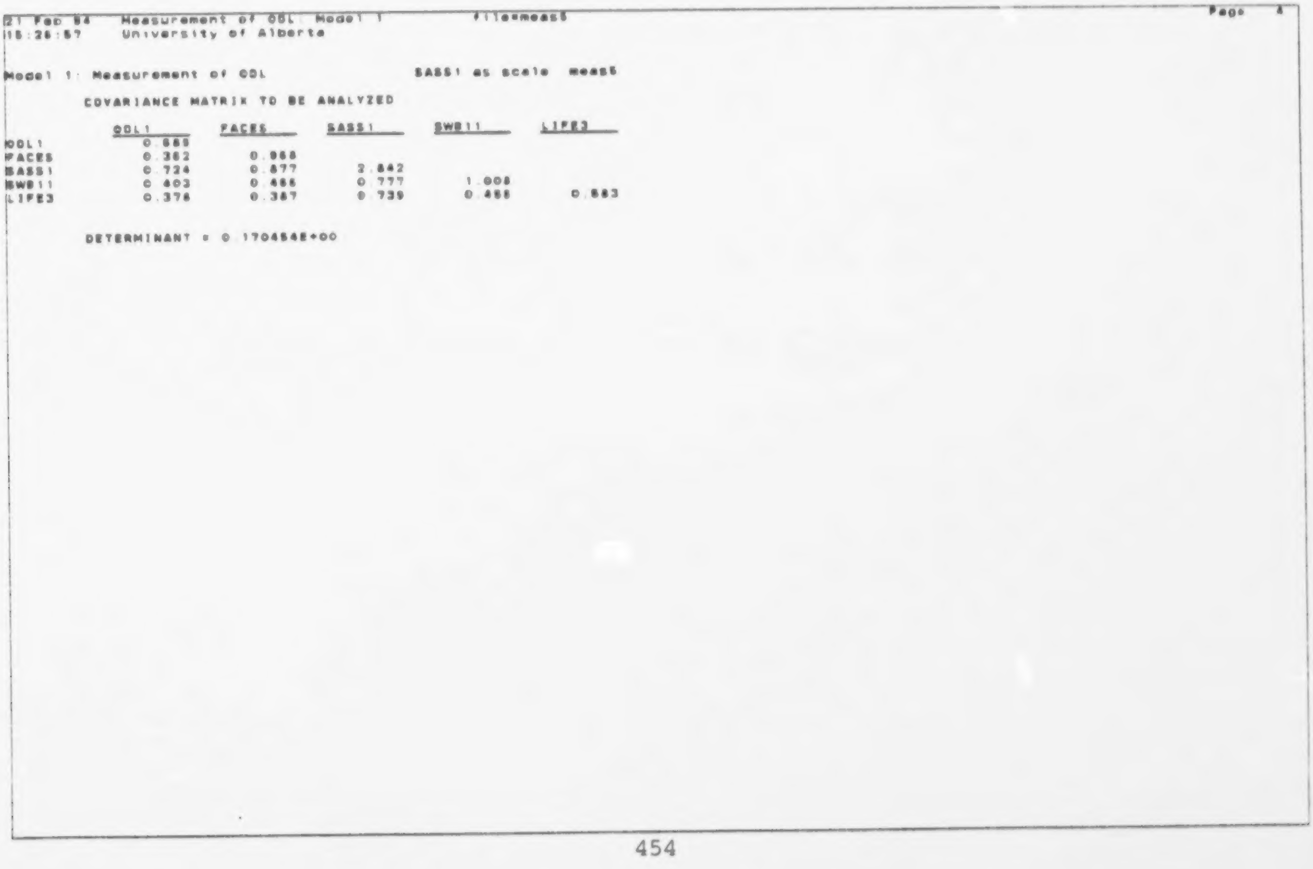
                          FACTOR SCORES REGRESSIONS  YES

                          FIRST ORDER DERIVATIVES    YES

                          STANDARDIZED SOLUTION      YES

                          PARAMETER PLOTS             NO

                          AUTOMATIC MODIFICATION      NO
```



```
21 Feb 84    Measurement of ODL: Model 1            File=meas5                              Page   4
15:26:57     University of Alberta

Model 1: Measurement of ODL                    SASS1 as scale  meas5

        COVARIANCE MATRIX TO BE ANALYZED

              ODL1       FACES      SASS1      SWB11      LIFE3
ODL1          0.685
FACES         0.382      0.868
SASS1         0.724      0.677      2.842
SWB11         0.403      0.466      0.777      1.008
LIFE3         0.376      0.387      0.739      0.458      0.583

        DETERMINANT = 0.170454E+00
```

University of Alberta

```
21 Feb 84   Measurement of ODL  Model 1          file=meas5                                                   Page  5
15:26:57    University of Alberta

Model 1  Measurement of ODL                  SASS1 as scale  meas5

PARAMETER SPECIFICATIONS

         LAMBDA Y

               ETA 1
ODL1               1
FACES              2
SASS1              0
SWB11              3
LIFE3              4

         PSI

               ETA 1
   ETA 1           5

         THETA EPS

             ODL1         FACES        SASS1        SWB11        LIFE3
ODL1               6
FACES              0            7
SASS1              0            0            0
SWB11              0            0            0            8
LIFE3              0            0            0            0            9
```

```
21 Feb 84   Measurement of ODL  Model 1          file=meas5                                                   Page  6
15:26:57    University of Alberta

Model 1  Measurement of ODL                  SASS1 as scale  meas5

STARTING VALUES

         LAMBDA Y

               ETA 1
ODL1           1.000
FACES          1.000
SASS1          1.000
SWB11          1.000
LIFE3          1.000

         PSI

               ETA 1
   ETA 1       2.200

         THETA EPS

             ODL1         FACES        SASS1        SWB11        LIFE3
ODL1           0.200
FACES          0.000        0.200
SASS1          0.000        0.000        1.421
SWB11          0.000        0.000        0.000        0.200
LIFE3          0.000        0.000        0.000        0.000        0.200

         SQUARED MULTIPLE CORRELATIONS FOR Y - VARIABLES

             ODL1         FACES        SASS1        SWB11        LIFE3
               0.710        0.783        0.500        0.802        0.857

         TOTAL COEFFICIENT OF DETERMINATION FOR Y - VARIABLES IS  0.987

         SQUARED MULTIPLE CORRELATIONS FOR STRUCTURAL EQUATIONS

               ETA 1
               0.000

         TOTAL COEFFICIENT OF DETERMINATION FOR STRUCTURAL EQUATIONS  IS  0.000
```

University of Alberta

```
21 Feb 84    Measurement of ODL  Model 1          File=meas5                                    Page   7
15:26:57     University of Alberta

        BEHAVIOR UNDER STEEPEST DESCENT ITERATIONS


        ITER  TRY    ABSCISSA           SLOPE              FUNCTION

          1    0     0.00000000E+00   -0.18637318E+02    0.10181312E+01
               1     0.10000000E+01    0.10648805E+01    0.15184048E+01
               2     0.75000000E+00    0.11795848E+01    0.12402979E+01
               3     0.56250000E+00    0.13176668E+01    0.10068292E+01

          2    0     0.00000000E+00   -0.80598533E+00    0.10068292E+01
               1     0.56250000E+00   -0.34795205E+00    0.74201917E+00
               2     0.90058877E+00    0.13712859E+01    0.79375914E+00
               3     0.73661726E+00    0.17683457E-01    0.70591527E+00

          3    0     0.00000000E+00   -0.75986480E+00    0.70591527E+00
               1     0.73661726E+00    0.28574002E+00    0.74527904E+00
               2     0.25901559E+00    0.53235088E-01    0.64518921E+00

          4    0     0.00000000E+00   -0.47695046E+00    0.64518921E+00
               1     0.25901559E+00   -0.22553347E+00    0.54558441E+00
               2     0.38938058E+00    0.10894182E+00    0.53660730E+00
               3     0.34179808E+00   -0.20071859E-02    0.53518781E+00

          5    0     0.00000000E+00   -0.52912190E+00    0.53518781E+00
               1     0.34179808E+00    0.75576738E-01    0.49057890E+00
               2     0.22592599E+00   -0.18433281E-01    0.48877159E+00

          6    0     0.00000000E+00   -0.39314783E+00    0.48877159E+00
               1     0.22592599E+00   -0.14839808E+00    0.41965228E+00
               2     0.30255238E+00    0.36533948E-01    0.41505715E+00

          7    0     0.00000000E+00   -0.58323453E+00    0.41505715E+00
               1     0.30255238E+00    0.17991645E+00    0.38399700E+00
               2     0.15272346E+00   -0.76090192E-02    0.37855374E+00

          8    0     0.00000000E+00   -0.27871769E+00    0.37855374E+00
               1     0.15272346E+00   -0.17587788E+00    0.34348372E+00
               2     0.31285032E+00    0.34770000E-01    0.33019532E+00
               3     0.29265347E+00   -0.92922052E-03    0.32989935E+00

          9    0     0.00000000E+00   -0.43852222E+00    0.32989935E+00
               1     0.29265347E+00    0.17071524E+00    0.31764862E+00
               2     0.14449128E+00   -0.29831354E-02    0.30337717E+00

         10    0     0.00000000E+00   -0.19559654E+00    0.30337717E+00
               1     0.14449128E+00   -0.11899168E+00    0.28022898E+00
               2     0.29728342E+00    0.13744850E-01    0.27129841E+00

         11    0     0.00000000E+00   -0.35139761E+00    0.27129841E+00
               1     0.29728342E+00    0.17078970E+00    0.28740715E+00
               2     0.13489479E+00    0.12129764E-02    0.25133548E+00
```

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21 Feb 84    Measurement of ODL  Model 1          File=meas5                                    Page   8
15:26:57     University of Alberta

         12    0     0.00000000E+00   -0.13808458E+00    0.25133548E+00
               1     0.13489479E+00   -0.92524556E-01    0.23863740E+00
               2     0.33003241E+00    0.84233659E-02    0.22858257E+00

         13    0     0.00000000E+00   -0.32497864E+00    0.22858257E+00
               1     0.33003241E+00    0.19080858E+00    0.23076750E+00
               2     0.13407472E+00    0.54307388E-02    0.20835457E+00

         14    0     0.00000000E+00   -0.12130482E+00    0.20835457E+00
               1     0.13407472E+00   -0.83477239E-01    0.19450591E+00
               2     0.34801303E+00    0.78147387E-02    0.18582422E+00

         15    0     0.00000000E+00   -0.31368451E+00    0.18582422E+00
               1     0.34801303E+00    0.20390531E+00    0.19427382E+00
               2     0.13372277E+00    0.72188588E-02    0.16810258E+00

         16    0     0.00000000E+00   -0.11328298E+00    0.16810258E+00
               1     0.13372277E+00   -0.78005590E-01    0.15519317E+00
               2     0.34620376E+00    0.59762927E-02    0.14885573E+00

         17    0     0.00000000E+00   -0.28988273E+00    0.14885573E+00
               1     0.34620376E+00    0.19684153E+00    0.15578683E+00
               2     0.13321684E+00    0.65073830E-02    0.13059281E+00

         18    0     0.00000000E+00   -0.10341662E+00    0.13059281E+00
               1     0.13321684E+00   -0.70478331E-01    0.11890473E+00
               2     0.34139458E+00    0.56457575E-02    0.11151521E+00

         19    0     0.00000000E+00   -0.26210155E+00    0.11151521E+00
               1     0.34139458E+00    0.17811153E+00    0.11912680E+00
               2     0.13293390E+00    0.48311734E-02    0.97172398E-01

         20    0     0.00000000E+00   -0.88888738E-01    0.97172398E-01
               1     0.13293390E+00   -0.59568719E-01    0.87217070E-01
               2     0.33550280E+00    0.39381205E-02    0.81116170E-01

         21    0     0.00000000E+00   -0.20172148E+00    0.81116170E-01
               1     0.33550280E+00    0.14981229E+00    0.85843006E-01
               2     0.13316911E+00    0.29885282E-02    0.69380507E-01

         22    0     0.00000000E+00   -0.69969355E-01    0.69380507E-01
               1     0.13316911E+00   -0.46818211E-01    0.61608638E-01
               2     0.32950514E+00    0.22534103E-02    0.57045275E-01

         23    0     0.00000000E+00   -0.14493909E+00    0.57045275E-01
               1     0.32950514E+00    0.11442403E+00    0.60931828E-01
               2     0.13433992E+00    0.14484683E-02    0.48329153E-01

         24    0     0.00000000E+00   -0.49262486E-01    0.48329153E-01
               1     0.13433992E+00   -0.31273341E-01    0.42880872E-01
               2     0.32395791E+00    0.10123857E-02    0.39865942E-01

         25    0     0.00000000E+00   -0.81881166E-01    0.39865942E-01
```

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21 Feb 94    Measurement of QOL  Model 1          File=meas5                                   Page  9
15:26:57     University of Alberta

                1    0.32385781E+00     0.77313664E-01     0.42088716E-01
                2    0.13655865E+00     0.52218152E-03     0.34104764E-01

         26     0    0.00000000E+00    -0.30484871E-01     0.34104764E-01
                1    0.13655865E+00    -0.18583191E-01     0.30735556E-01
                2    0.31877882E+00     0.34516061E-03     0.28013128E-01

         27     0    0.00000000E+00    -0.60889120E-01     0.28013128E-01
                1    0.31877882E+00     0.45157475E-01     0.30011847E-01
                2    0.13881352E+00     0.13155535E-03     0.25685972E-01

         28     0    0.00000000E+00    -0.16283775E-01     0.25685972E-01
                1    0.13881352E+00    -0.85073301E-02     0.23876278E-01
                2    0.31386318E+00     0.87355957E-04     0.23036056E-01

         29     0    0.00000000E+00    -0.24205531E-01     0.23036056E-01
                1    0.31386318E+00     0.22429876E-01     0.23376708E-01
                2    0.14314088E+00     0.21693039E-04     0.21374626E-01

         30     0    0.00000000E+00    -0.75555956E-02     0.21374626E-01
                1    0.14314088E+00    -0.62142780E-02     0.20528303E-01
                2    0.31028044E+00     0.18757121E-04     0.20173325E-01

         31     0    0.00000000E+00    -0.10257847E-01     0.20173325E-01
                1    0.31028044E+00     0.95781228E-02     0.20253330E-01
                2    0.14890162E+00     0.23127705E-05     0.18440112E-01

         32     0    0.00000000E+00    -0.31749308E-02     0.18440112E-01
                1    0.14890162E+00    -0.17124813E-02     0.18080272E-01
                2    0.31063657E+00     0.27586386E-05     0.18838038E-01
```

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21 Feb 94    Measurement of QOL  Model 1          File=meas5                                   Page 10
15:26:57     University of Alberta

         BEHAVIOR UNDER MINIMIZATION ITERATIONS

         ITER  TRY     ABSCISSA            SLOPE               FUNCTION

            1    0     0.00000000E+00     -0.88356252E-02     0.18838038E-01
                 1     0.10000000E+01      0.46353008E-03     0.15419848E-01

            2    0     0.00000000E+00     -0.18378834E-03     0.15419848E-01
                 1     0.10000000E+01      0.10344413E-04     0.15333802E-01

            3    0     0.00000000E+00     -0.14888038E-04     0.15333802E-01
                 1     0.10000000E+01     -0.25797728E-05     0.15325026E-01
                 2     0.12084115E+01      0.88709880E-08     0.15324760E-01

            4    0     0.00000000E+00     -0.11333586E-06     0.15324760E-01
                 1     0.12084115E+01      0.48505221E-08     0.15324694E-01

            5    0     0.00000000E+00     -0.18021173E-08     0.15324694E-01
                 1     0.12084115E+01      0.18556369E-09     0.15324694E-01
                 2     0.10828787E+01      0.41633338E-14     0.15324694E-01
```

```
21 Feb 84   Measurement of QOL: Model 1          file=meas5                                         Page  11
15:26:57    University of Alberta

Model 1: Measurement of QOL                      SASS1 as scale  meas5

LISREL ESTIMATES (MAXIMUM LIKELIHOOD)

        LAMBDA Y

                ETA 1
              ________
QOL1            0.482
FACES           0.540
SASS1           1.000
SWB11           0.583
LIFE3           0.523

        PSI

                ETA 1
              ________
   ETA 1        1.439

        THETA EPS

              QOL1        FACES       SASS1       SWB11       LIFE3
              ________    ________    ________    ________    ________
QOL1            0.341
FACES           0.000       0.547
SASS1           0.000       0.000       1.421
SWB11           0.000       0.000       0.000       0.519
LIFE3           0.000       0.000       0.000       0.000       0.189

        SQUARED MULTIPLE CORRELATIONS FOR Y - VARIABLES

              QOL1        FACES       SASS1       SWB11       LIFE3
              ________    ________    ________    ________    ________
                0.505       0.434       0.500       0.485       0.676

        TOTAL COEFFICIENT OF DETERMINATION FOR Y - VARIABLES IS  0.847

        SQUARED MULTIPLE CORRELATIONS FOR STRUCTURAL EQUATIONS

                ETA 1
              ________
                0.000

        TOTAL COEFFICIENT OF DETERMINATION FOR STRUCTURAL EQUATIONS  IS  0.000
```

```
21 Feb 84   Measurement of QOL: Model 1          file=meas5                                         Page  12
15:26:57    University of Alberta


                MEASURES OF GOODNESS OF FIT FOR THE WHOLE MODEL

    CHI-SQUARE WITH   6 DEGREES OF FREEDOM IS       9.35 (PROB  LEVEL = 0.155)

                          GOODNESS OF FIT INDEX IS 0.986

                     ADJUSTED GOODNESS OF FIT INDEX IS 0.960

                      ROOT MEAN SQUARE RESIDUAL IS     0.033
```

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21 Feb 94   Measurement of QOL: Model 1          File=meas5                                              Page  13
15:26:57    University of Alberta

Model 1: Measurement of QOL                  SASS1 as scale  meas5

MODIFICATION INDICES

        LAMBDA Y

               ETA 1
QOL1           0.000
FACES          0.000
SASS1          0.000
SWB11          0.000
LIFE3          0.000

        PSI

               ETA 1
   ETA 1       0.000

        THETA EPS

               QOL1       FACES      SASS1      SWB11      LIFE3
QOL1           0.000
FACES          1.105      0.000
SASS1          0.265      5.753      0.036
SWB11          0.283      0.254      2.544      0.000
LIFE3          0.709      2.786      0.502      2.385      0.000

       MAXIMUM MODIFICATION INDEX IS    5.75 FOR ELEMENT ( 3, 2) OF THETA EPS
```

```
21 Feb 94   Measurement of QOL: Model 1          File=meas5                                              Page  14
15:26:57    University of Alberta

Model 1: Measurement of QOL                  SASS1 as scale  meas5

STANDARD ERRORS

        LAMBDA Y

               ETA 1
QOL1           0.044
FACES          0.051
SASS1          0.000
SWB11          0.053
LIFE3          0.041

        PSI

               ETA 1
   ETA 1       0.212

        THETA EPS

               QOL1       FACES      SASS1      SWB11      LIFE3
QOL1           0.034
FACES          0.000      0.051
SASS1          0.000      0.000      0.000
SWB11          0.000      0.000      0.000      0.050
LIFE3          0.000      0.000      0.000      0.000      0.024
```

```
21 Feb 94    Measurement of QOL  Model 1           file=meas5                                                          Page  15
15:26:57     University of Alberta

Model 1: Measurement of QOL                   SASS1 as scale  meas5

T-VALUES

         LAMBDA Y

              ETA 1
           --------
QOL1         11.288
FACES        10.509
SASS1         0.000
SWB11        11.081
LIFE3        12.781

         PSI

              ETA 1
           --------
   ETA 1      6.803

         THETA EPS

              QOL1       FACES       SASS1       SWB11       LIFE3
           --------    --------    --------    --------    --------
QOL1         10.109
FACES         0.000      10.678
SASS1         0.000       0.000       0.000
SWB11         0.000       0.000       0.000      10.283
LIFE3         0.000       0.000       0.000       0.000       7.814
```

```
21 Feb 94    Measurement of QOL  Model 1           file=meas5                                                          Page  16
15:26:57     University of Alberta

Model 1: Measurement of QOL                   SASS1 as scale  meas5

         CORRELATIONS OF ESTIMATES

               LY 1 1      LY 2 1      LY 4 1      LY 5 1      PS 1 1      TE 1 1      TE 2 2      TE 4 4      TE 5 5
             --------    --------    --------    --------    --------    --------    --------    --------    --------
  LY 1 1        1.000
  LY 2 1        0.449       1.000
  LY 4 1        0.474       0.441       1.000
  LY 5 1        0.541       0.506       0.532       1.000
  PS 1 1       -0.585      -0.544      -0.574      -0.573       1.000
  TE 1 1       -0.192       0.004       0.005       0.032       0.013       1.000
  TE 2 2        0.004      -0.169       0.004       0.022       0.009      -0.022       1.000
  TE 4 4        0.005       0.003      -0.185       0.028       0.012      -0.028      -0.020       1.000
  TE 5 5        0.022       0.013       0.019      -0.281       0.048      -0.112      -0.079      -0.102       1.000
```

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```
21 Feb 84   Measurement of QOL: Model 1          file=meas5                                    Page 17
15:26:57    University of Alberta

Model 1: Measurement of QOL                    SASS1 as scale: meas5

FITTED MOMENTS AND RESIDUALS

        FITTED MOMENTS

             QOL1        FACES       SASS1       SWB11       LIFE3
QOL1         0.889
FACES        0.383       0.958
SASS1        0.708       0.776       2.860
SWB11        0.413       0.454       0.838       1.008
LIFE3        0.370       0.407       0.753       0.438       0.583

        FITTED RESIDUALS

             QOL1        FACES       SASS1       SWB11       LIFE3
QOL1         0.000
FACES       -0.021      -0.000
SASS1        0.016       0.059      -0.018
SWB11       -0.010       0.012      -0.063      -0.000
LIFE3        0.007      -0.020      -0.014       0.017       0.000

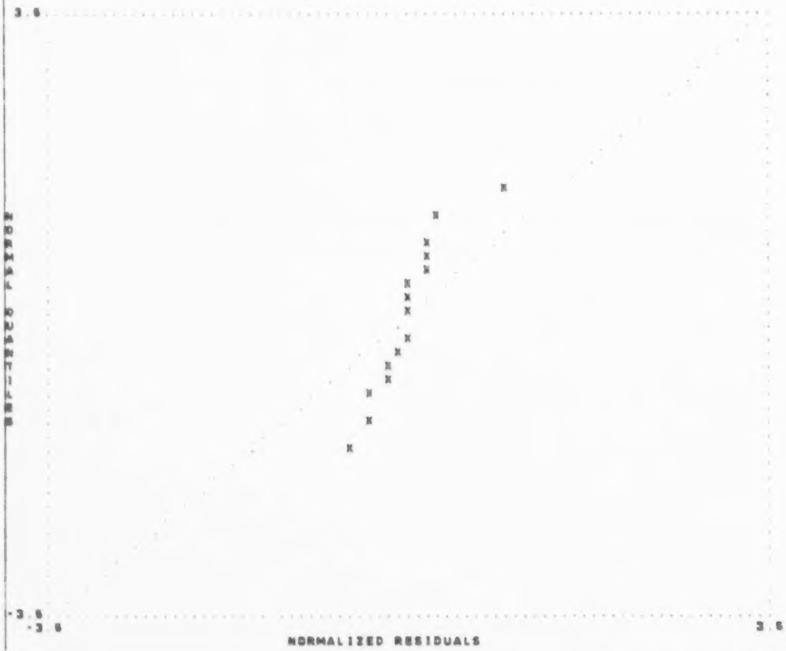
        NORMALIZED RESIDUALS

             QOL1        FACES       SASS1       SWB11       LIFE3
QOL1         0.000
FACES       -0.387      -0.000
SASS1        0.160       0.845      -0.077
SWB11       -0.185       0.188      -0.577      -0.000
LIFE3        0.172      -0.401      -0.163       0.330       0.000
```

```
21 Feb 84   Measurement of QOL: Model 1          file=meas5                                    Page 18
15:26:57    University of Alberta

Model 1: Measurement of QOL                    SASS1 as scale: meas5

                     QPLOT OF NORMALIZED RESIDUALS
```



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21 Feb 94   Measurement of ODL: Model 1          File=meas5                                          Page  19
15:26:57    University of Alberta

Model 1: Measurement of ODL                    SASS1 as scale  meas5

TOTAL EFFECTS

        TOTAL EFFECTS OF ETA ON  ETA

                 ETA 1
   ETA 1      ________
                 0.000
        TOTAL EFFECTS OF ETA ON  Y

                 ETA 1
              ________
ODL1             0.492
FACES            0.540
SASS1            1.000
SWB11            0.583
LIFE3            0.523
```

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21 Feb 94   Measurement of ODL: Model 1          File=meas5                                          Page  20
15:26:57    University of Alberta

Model 1: Measurement of ODL                    SASS1 as scale  meas5

VARIANCES AND COVARIANCES

        ETA - ETA

                 ETA 1
   ETA 1      ________
                 1.439

        Y - ETA

                 ETA 1
              ________
ODL1             0.708
FACES            0.776
SASS1            1.439
SWB11            0.839
LIFE3            0.753
```

```
21 Feb 94   Measurement of QOL  Model 1          File=meas5                                              Page  21
15:26:57    University of Alberta

Model 1: Measurement of QOL                    SASS1 as scale  meas5

FIRST ORDER DERIVATIVES

        LAMBDA Y

               ETA 1
            ---------
QOL1          -0.000
FACES          0.000
SASS1         -0.000
SWB11          0.000
LIFE3         -0.000

        PSI

               ETA 1
            ---------
   ETA 1       0.000

        THETA EPS

              QOL1       FACES       SASS1       SWB11       LIFE3
            ---------  ---------  ---------  ---------  ---------
QOL1          -0.000
FACES          0.110      0.000
SASS1         -0.033     -0.128      0.003
SWB11          0.056     -0.043      0.085     -0.000
LIFE3         -0.112      0.159      0.052     -0.170      0.000
```

```
21 Feb 94   Measurement of QOL  Model 1          File=meas5                                              Page  22
15:26:57    University of Alberta

Model 1: Measurement of QOL                    SASS1 as scale  meas5

FACTOR SCORES REGRESSIONS

        ETA

              QOL1       FACES       SASS1       SWB11       LIFE3
            ---------  ---------  ---------  ---------  ---------
   ETA 1       0.304      0.208      0.148      0.237      0.583
```

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```
21 Feb 84   Measurement of ODL: Model 1          File=meas5                                               Page  23
15:26:57    University of Alberta

Model 1: Measurement of ODL                    SASS1 as scale  meas5

STANDARDIZED SOLUTION

        LAMBDA Y

                ETA 1
            ---------
ODL1            0.590
FACES           0.648
SASS1           1.200
SWB11           0.700
LIFE3           0.828

        PSI

                ETA 1
            ---------
   ETA 1        1.000

        CORRELATION MATRIX FOR ETA

                ETA 1
            ---------
   ETA 1        1.000

THE PROBLEM REQUIRED  1828 DOUBLE PRECISION WORDS,
THE CPU-TIME WAS       0.42 SECONDS
```

```
21 Feb 84   Measurement of ODL  Model 1          File=meas5                                               Page  24
15:26:57    University of Alberta

PRECEDING TASK REQUIRED        0.63 SECONDS CPU TIME;        2.86 SECONDS ELAPSED.

  36   0

    35 COMMAND LINES READ.
     0 ERRORS DETECTED.
     0 WARNINGS ISSUED.
     1 SECONDS CPU TIME.
     4 SECONDS ELAPSED TIME.
       END OF JOB.
```